ENGINEERING NEWS

THE NICARAGUA BILL, has at last passed the House by the large majority of 177 to 60 — nearly 3 to 1—; its passage being greeted by the very unusual incident of loud applause, showing that a heavy majority of the members feel a deep interest in the measure as Americans, as well they may. The papers state that the bill now goes to the President, but this we believe is incorrect. It has first to pass the Senate, on account of certain trifling changes made in it by the Conference Committee from the form in which it first passed the Senate. But in any case this is a merely formal matter, as the Senate has all along been favorable, and as the main changes by the Conference Committee were to throw out the absurd and burdensome House amendments—as to Congress controlling tolls; no stock to be issued except as paid for in cash at par; etc.,—which would have so loaded the project as to make it impossible to raise money for it from prudent capitalists; and to restore the bill to the form in which it originally passed the Senate. It cannot be questioned that the President will sign the bill, and probably with pleasure; thus consummating what is generally admitted to be the most important measure which has passed the present Congress, and one whose possible far-reaching consequences it would be difficult to exaggerate. Work is likely to be started on the canal very soon, there being a considerable fund of cash now in hand (over $2,000,000) with which to start work at once without raising any more capital. This money was recently raised with the greatest ease, and this fact, we think, leaves good ground for hoping that the entire capital for construction may be raised in this country.

THE PANAMA CANAL CO. is now in process of liquidation and final winding up by an officer, whom we should call a receiver, appointed on application of the company. Of the proposed last loan of 120,000 shares (of $100 each), only 9,000 are even claimed to have been subscribed. The collapse of the company has been so discounted for several years that it has produced far less financial commotion than could have been reasonably anticipated; and it is not in the least likely that anything more will ever be heard of the great Panama canal project, until the Nicaragua canal has been built and become such a financial success as to excite the cupidity of capitalists, and lead to projects for an opposition canal or ship railway.

THE CHICAGO DRAINAGE COMMISSION has presented its report, and sends in with the report a bill providing for a drainage district with a drainage channel, etc., as follows: In rock formation the channel shall be 160 ft. wide at the bottom and have a capacity of 600,000 cu. ft. per minute and a minimum depth of 18 ft. Through alluvial or clay formation it shall be not less than 14 ft. deep and have a flow of 300,000 cu. ft. per minute. Whenever the U. S. Government shall improve the Desplaines and Illinois rivers sufficiently to receive 600,000 cu. ft. per minute, and pay all damage to private property caused by any excess of 300,000 cu. ft. capacity; the drainage district shall enlarge the entire channel to 600,000 cu. ft. per minute and 18 feet depth. If the U. S. Government does not improve said rivers, then as soon as the district population shall reach or exceed 1,500,000, the channel is to be enlarged by the district so that there shall be at all times not less than 20,000 cu. ft. per 100,000 of inhabitants. The commission unanimously recommends the passage of such a bill. The Chicago sewage is now diluted at the rate of 5,000 cu. ft. per 100,000 inhabitants. The cost of the canal is estimated at $10,000,000.

THE INTERSTATE RAILWAY ASSOCIATION only lacks the signatures of its members to go into effect, and strong efforts are being exerted to bring in the few companies which still hang back. These are the Chicago, Burlington & Northern, the Illinois Central, the Kansas City, Ft. Scott & Gulf, and the Missouri, Kansas & Texas. President PERKINS of the Burlington system is reported to be unwilling to sign until these roads come in. It is undoubtedly the wisest thing to employ every possible means now to bring in all the companies in the territory included, since outside competition would furnish a most dangerous rock on which the Association might split. Certainly the danger of "going it alone" has been fully shown by the experience of the past year, and it is difficult to see what valid excuse Messrs. FISH and NETTLETON can have for opposing the movement toward harmony.

THE INTERSTATE COMMERCE COMMISSION, has sent out the following circular letter to each of the State Railroad Commissions.

The State Railroad Commissions, with gratifying unanimity, have heartily approved the suggestion for a general meeting, and many who desire to attend have indicated the first week in March as the most convenient time. You are therefore invited to participate in a general conference of Railroad Commissioners, to be held at the office of the Interstate Commerce Commission, No. 1317 F St., in the City of Washington, at 11 o'clock A. M., on the 5th day of March, 1889.

Among the subjects which may be properly considered are the following:

RAILWAY STATISTICS, with especial reference to the formulation of a uniform system of reporting;

CLASSIFICATION OF FREIGHT, its simplification and unification;

RAILWAY LEGISLATION, how to obtain harmony in;

RAILWAY CONSTRUCTION, should regulation be provided;

And such other topics affecting State and Interstate Commerce as may be brought forward by members of the Conference, the above suggestions not being designed to exclude the consideration of any other subjects of common interest.

An opportunity will also be afforded for consultation in respect to the heating and lighting of cars, automatic car-coupling, continuous train-brakes, and other matters now more particularly within the sphere of State authority.

Brief papers are invited from members of the Conference upon any topic deemed of importance. Arrangements will be made for preserving a permanent record of the proceedings.

THE ABOLITION OF GRADE CROSSINGS in Massachusetts is being considered by a special commission, which reports that there are 2,280 such crossings in that State, of which 1,393 are unprotected by gates, flags or bells; leaving 887 so protected, a much larger percentage than exists in most of the States. The commission truly declares that the expense of abolishing this source of danger is likely to grow greater with each, year and well remarks that "if steps are to be taken for their gradual abolition the first thing to be done is to stop making new ones." Whether the Legislature will heed their advice remains to be seen: but grade crossings are evidently becoming generally obnoxious and unpopular, as they ought to.

THE INTERNATIONAL CABLE CO., Sir WM. ARMSTRONG, President, is asking the British Government for a subsidy to lay a cable from Halifax to Bermuda, and two cables from England to Halifax, one direct and the other via Lisbon. The Bermuda cable is to connect with the West India islands, including the Bahamas, and eventually to be laid from the latter point to Charleston, S. C.

AN INSTRUCTION CAR has been built at Altoona for GEO. WESTINGHOUSE, JR., which is designed to exhibit to railroad men the practical workings of all the Westinghouse appliances, consisting of working models of the latest improved air brake for passenger and freight cars, the new friction buffer air signal, steam heating apparatus, electric lighting, and in fact everything pertaining to the mechanical equipment. A 15 H. P. boiler will supply steam to a Westinghouse engine which will operate a dynamo, while a tank with a capacity of 6,000 lbs. will carry a supply of water under the car.

THE THURLOW CAST STEEL GUN is being tried as we go to press at the Naval Ordnance Proving Grounds, too late for us to announce the result, which we earnestly hope is to be more favorable than the last untoward experiment. Even if it should not be, it does not appear to us just grounds for entirely abandoning further experiments in cast-steel ordnance, which may well require many experiments before satisfactory results are attained, and yet lead to entirely satisfactory results in the end. The gun is a 6-in. breech-loading rifle, made of open hearth steel, cast by the Standard Steel Casting Co., of Thurlow, Penn. It is 16 ft. 3 ins. long, 22.2 ins. across breech, weighs 13,125 lbs. and throws a shell weighing 100 lbs., with a powder charge of 48¾ lbs., or the same as used for the regular naval 6 in. gun. We have just time to add that the gun has successfully stood the Government test of ten rounds with 48¾ lbs. of powder and a 100 lb shell.

RAILWAY RATES IN IOWA must come down. The expected order was issued by Judge BREWER of the United States Circuit Court on February 2, removing the injunction issued by him last July against the enforcement of the schedule of rates adopted by the Iowa State Railway Commission. The officers of most of the Iowa roads have already notified the Commission that they will abide by the law, and will reduce their rates to the Commission's schedule. They do this, however, under protest, and will appeal to the United States Supreme Court. The decision of that body in the matter will be the most important which it has been called upon to make in this matter since the Granger cases.

The amount of the reduction is variously estimated at 15 to 30 per cent., and the effect of the reduction will be felt far beyond the boundaries of Iowa.

BRIDGE AND TRESTLE accidents are reported as follows: On Jan. 30, a broken rail on the Camden branch of the South Carolina Railway, near the trestle at Rafting creek, derailed five cars of a freight train, and 60 ft. of the trestle was knocked down.——The highway bridge over Swift bayou on the Rush Point road, near Shreveport, La., was washed away by flood recently.——A bridge being constructed over Crooked creek, in the northern part of Atchison county, Kan., fell last week. Eight men were injured, one fatally.

AN EARTHQUAKE SHOCK was felt at Grand Metis, Que., on Feb. 5. The shock was slight.

A LANDSLIDE occurred on the Atchison, Topeka & Santa Fé road, between Los Angeles and San Diego, Cal., on Jan. 31. A man discovered the obstruction and lighted a bonfire on the track, which served as a signal to an approaching train.

THE MOST SERIOUS RAILWAY ACCIDENT of the week was the derailment of a St. Louis & San Francisco switch engine at Springfield, Mo., on Feb. 3. The engine was running about 15 miles per hour when it left the track at a switch; of ten men on the engine, three were killed and five seriously injured. ——At Boston, Mass., a Boston and Lowell switch engine was derailed at a switch and fell over on its side, imprisoning the engineer in the cab. Before he could be extricated a heavy freight train ran into the engine. The engineer was killed.

THE NEW YORK & BROOKLYN TUNNEL CO. is before the New York Legislature asking for incorporation. The plan is to build a tunnel of iron or masonry under the East river, from a point near Whitehall or State Sts., in New York, to a point near Atlantic Ave. in Brooklyn. The capital named is $12,000,000, and the tunnel is to be commenced in 2 years and completed within 5 years thereafter. The bill offered names JOHN N. DRAKE, WM. H. DUCKWORTH, ED. S. FOWLER, JAMES BARKER, DAVID HUNT, H. SIMONSON and LEWIS F. DODD among 13 incorporators.

AMONG OTHER RAILWAY ACCIDENTS we note the following: The cable of the Delaware & Hudson gravity road at Honesdale, Pa., broke one day last week while hauling up a passenger train. The cars ran to the bottom of the grade without accident, but the passengers were badly shaken up.——On January 29, an engine was struck by one of the doors used to close the west portal of the Hoosac tunnel in winter, and the engineer was seriously injured.——On January 31, a heavily loaded stone train on the Salt Lake & Fort Douglas Railway, in Utah, ran away on a steep grade owing to ice on the rails, and finally jumped the track. Two men were killed.——On February 1 a freight car on the Mobile & Girard road jumped the track on the trestle at Columbus, Ga., but ran safely across the structure.——On February 2, the boiler of a new Chicago, Burlington & Quincy engine, burst while hauling a train near Plano, Ill.; one man was killed.——On February 4 a steam pipe explosion occurred in a Delaware & Hudson passenger car at Carbondale, Pa. The car was one of a train that had just been run into the station, and the accident is said to have been caused by the turning on of the steam from the other cars into the pipes of this car which were frozen.

THE ST. LAWRENCE RIVER BRIDGE, at Coteau, P. Q., has been let as far as the superstructure is concerned, to the Dominion Bridge Co., of Montreal, by the Canada Atlantic Railway Co. The superstructure will be of steel and the total length of the metal work will be about 3,900 ft.; made up of one 145 ft. and two 180 ft. fixed spans and a 355 ft. span over the North Channel; ten 215 ft. spans over the Middle Channel and four 223 ft. spans over the South Channel. The bridge will be 16 feet clear width between trusses and will have four lines of rolled iron track stringers. It is to be completed on or before Dec. 1, 1889.

THE DALLES NAVIGATION is to be still further investigated by the board of engineers, their first report being considered as preliminary. They will consider; First—The change in the original plans which arranged for two sections of the line, to plans for a continuous railway from below the Dalles to above Celilo. Second—the system of hydraulic lifts. Third—the Eads system of ship railways. The latter project seems to be growing in favor.

THE CAR STOVE is being considered by the Minnesota railway commissioners and they have issued a report regarding their investigations and recommend the passage of a bill providing that no passenger, mail or baggage car on any railroad in the State shall be heated by any furnace or heater unless approved by the railroad and warehouse commission, but in no event shall a common stove be allowed in any such car. The term "common stove" is to include all stoves that heat by direct radiation. The bill provides a penalty of $500 for violating this law. In concluding, the commissioners say they have not found it expedient to take any action under the section regarding the lighting of cars, as they are not of opinion that the public safety required the substitution of other methods of lighting as yet, although many passenger trains are at night cheaply and inadequately lighted.

THE MONTREAL HARBOR SCHEME, now being started at an estimated cost of $4,000,000, will give 4 miles of wharfage and a still-water basin of 6 sq. miles. A pier is to be built to the middle of the river to form a basin and protect the wharves from running ice, and the street along the river front is to be widened from 35 ft. to 100 ft.

THE UNION PACIFIC has instructed its general attorney to draft a bill to be submitted to the present legislature providing for the creation of an office known as the "State Inspector of Locomotive Engines," which said officer's duties shall be to inspect all engines run over the lines of road in the State of Nebraska at least twice per year, or as frequently as the exigencies of the case demand.

THE GOVERNMENT OPERATION OF RAILWAY LINES seems to be a success financially in Prussia. They are said not only to pay expenses, but are a source of revenue. The net surplus eight years ago was $17,000,000, and this had grown last year to $65,000,000, and will be over $77,000,000 this year, it is estimated.

THE ROAD LAW OF 1887, which the board of supervisors of Roanoke Co., W. Va., are asked to adopt, imposes a tax of from 5 to 15 cts. on each $100 of valuation, to be expended on the roads in each district taxed. The *Roanoke Times* says that the Big Lick district favors the maximum taxation of 15 cts. and it is expected that this sum will be increased by individual subscriptions, so that the main roads, at least, can be put in good order next year.

THE NATIONAL BALLAST CO., of Chicago, is said to have made a proposition to the city of Houston, Texas, to pave that city with burnt clay. St. Joseph, Mo., and a seven years trial on a Chicago boulevard, are given as examples of the durability of this type of paving material. The proposition is to put down a 12-in. foundation of this burnt clay and macadamise the surface, at a cost not exceeding 50 per cent. of the present estimated cost of paving Houston.

THE KANSAS STATE AGRICULTURAL COLLEGE has been honored by the Department of Agriculture selecting it to represent the class of agricultural colleges at the Paris exposition by a collection of photographs, plans, schemes of instruction, etc. The space is so limited that the number of institutions that exhibit in displayed detail is limited to one from each class. That the Kansas College should be selected for this purpose speaks well for its organization.

LONDON PLUMBERS must obtain certificates of fitness from the Plumber's Company before their names can be placed in the list of recommended plumbers printed on the backs of the notices served by the New River Company for water supply.

THE SIBERIAN RAILWAY is carefully surveyed for the 800 miles between Tomsk and Atchinsk, and the working drawings are being prepared, under the pressure of the probable commencement of work, next Spring. Gen. ANNENKOFF is asking for Government permission to extend the Trans-Caspian line from Samarkand to Tashkent. But Russian finances are not particularly elastic.

A SOUTHERN CALIFORNIA EXHIBIT ON WHEELS is the last bit of enterprise of the land syndicates of that section. Two cars will be fitted out to exhibit the products of the country, and lectures with stereopticon illustrations will form part of the scheme. Commencing at Chicago, this exhibition train will pass through the Middle and New England States, stopping to deliver free lectures at the villages, towns and cities on the way.

A BUFFALO SYSTEM OF CANALS AND DOCKS is being engineered by Messrs. O. O. COTTLE and associates. The plan includes the extending of the south end of the Blackwell canal about one mile and making it all 200 ft. wide. It is to be navigable for large vessels and provided with docks, slips and branches. It is believed that the canal could be extended and laterals dug for about $150,000.

THE LONGEST RAILWAY TANGENT in the world is probably on the new Argentine Pacific railroad from Buenos Ayres to the foot of the Andes. It is 211 miles without a curve. It is also a remarkable fact that in this distance there is not a single bridge and no opening larger than an ordinary culvert. The level nature of the country will be appreciated from the statement of the further fact that on the 211 miles there is no cut greater than 1 meter in depth and no fill of a height exceeding 1 meter. The country, in fact, seems to be almost an ideal one for railroad construction. There are some drawbacks, however; one being that there is almost an entire absence of wood on the plain across which the western end of the road is located. This has led to the extensive use of metallic ties, which will be used on nearly the entire road. Work has already been commenced on the mountain section of the road, which is to cross the Andes and unite with the Chilian line.

A RIEHLE VERTICAL SCREW-POWER TESTING MACHINE, of 100,000 lbs. capacity, has been reported upon by a board of engineers appointed by order of Major General SCHOFIELD, U. S. A., by direction of the Secretary of War. In closing this report it says: "The board is of the opinion that the machine examined is constructed on correct mechanical principles; the parts are well disposed, and there seems to be no reason why such a machine should not give results of sufficient accuracy. It is subject to the objection that inheres in all knife-edge machines, and the defect of friction on the fulcrum. If these parts are made with great care and of the hardest materials, the amount of this friction is reduced to a minimum."

THE BOYNTON BICYCLE RAILWAY was tested at Portland, Maine, last week, with results pronounced highly satisfactory by the inventor and his friends. Those present say the machine ran smoothly and easily, with "indications of great power and great possibilities in the matter of speed." The experimental machine has a wheel 8 ft. in diameter driven by two engines of 12 x 14 ins. The piston speed is from 550 to 600 turns per minute, each car is to seat 88 persons, and the cars are to weigh only 7 tons each. A speed of 100 miles per hour is promised. The economy claimed is in great saving in dead load, a saving of 10 to 1 in necessary power, decreased cost of equipment and as great safety as is now possible at a speed of 20 miles per hour.

PANAMA STOCK, of the par value of 500 fr., was offered on the Paris Bourse on Feb. 6, at 57.50 fr., less than one-eight of its nominal value.

A UNION PASSENGER STATION is to be built at Pueblo, Col. Plans have been agreed on by the companies whose lines center there and work is to begin soon. The structure will be of red sandstone, and will cost between $200,000 and $300,000.

The Errors of Indicators.

Some tests were recently made by Chief Engineer DAVID SMITH, U. S. N., and Assistant Engineers WINDSOR and BARRY, to determine the limits of error in two prominent makes of indicators, viz., the Thompson indicator, manufactured by the American Steam Gauge Co., and the Tabor, manufactured by the Ashcroft Manufacturing Co. The results are shown graphically in the accompanying diagrams, showing the best and worst diagram obtained from each, the test being made as follows. The indicators tested were said to have been taken from stock, and to be precisely like all others in the market.

MANNER OF MAKING THE TESTS.

The steam gauge having been secured in place, steam was blown through the test pipe and indicator nipples several times to free the pipe of water and dirt.

The indicators, after being well oiled, were secured in position and steam admitted, the pressure being allowed to rise until the limit for which the springs were designed was reached, in order to bring the instruments to their working temperature.

After trying the instruments to see that their movements were free, steam was discharged from the test pipe and the indicator cocks closed. The piston of each instrument was then pressed down slightly by hand and allowed to return to its normal position, with the friction of the moving parts opposed to the movement of the spring. When this had been done, the atmospheric line was drawn across the card. Steam was then admitted to the instruments, and so regulated that the hand of the steam gauge would rise slowly to the interval of pressure to be noted, and when it reached that point, at the word "Mark," an operator stationed at each instrument drew the required line of its scale. All lines of the scales were drawn in the same manner, the top steam line of the first test of each series being extended across the card.

Before beginning the down scales, the steam was allowed to rise a pound or two above the pressure to be first noted, in order to oppose the friction of the instrument to the movement of the spring. At the end of the down scale, the steam was shut off and discharged from the pipe and the indicator cock closed before drawing the atmospheric line.

After making several scales in the manner described, the representatives of both makers expressed their dissatisfaction with the irregularities found in them, which they attributed to the defects of the steam gauge used rather than to any fault in their instruments. They requested that another gauge be substituted, and offered to furnish one that was known by them to be correct. The Board accepted the offer.

An indicator test gauge with a 12-in. face was furnished by the Ashcroft Manufacturing Co., with the statement that it agreed with their mercury column, and was the one used at their works for testing indicators. This gauge was accepted by the representative of the American Steam Gauge Company, as well as by the Board, and was used in making all the scales of the 30, 40, and 60-lb. springs; while a compound gauge (of the American Steam Gauge Co.'s make) belonging to the yard was used in making the scales of the 20-lb. spring.

To determine the comparative indications of identically the same power by the two instruments, each fitted with 20 and with 40-lb. springs, the following method was used.

The indicator pipe at the outer end of the machine-shop engine was fitted with a T and two right-angle branch pipes of equal diameters and lengths terminating in nipples. To the latter, the indicators were attached, after clearing the pipes of water and dirt and lubricating the cylinders. The springs of the paper drums were adjusted to approximately the same tension. The cords around these drums were tied to each other and to a single cord connecting with the indicator motion. This arrangement gave coincident motion to both drums without sensibly affecting the lead of the cords, as the angle between the latter was small.

One operator could readily take cards from both indicators at the same time.

Ten cards having been taken from each indicator, the latter were interchanged and then ten more cards taken from each. This change was made in order to eliminate any errors due to possible differences in the bore and lead of the branch pipes.

Two sets of cards were thus taken, one with 20-lb. springs in the indicators, and the other with 40.

RELATIVE MOVEMENTS OF PENCIL AND PISTON.

The test to determine this was made as follows:

The spring of each indicator having been removed, a micrometer gauge was fitted to the cylinder and the weight of the piston and attachment taken on the end of the micrometer screw, the zero of the wheel coinciding with that of the vernier. A line was then drawn with the pencil of the instrument and formed the first one of the scale. The micrometer screw was then turned one revolution and a second line drawn; this was repeated

until the scale was complete for the movement of the piston.

From these scales the intervals are found to be 1-10-in. for the Thompson and ¼-in. for the Tabor indicator.

As the pitch of the micrometer screw is 1-40-in., the pencil movement of the former is four times, and of the latter five times, that of its piston.

The intervals of the Tabor scale are very uniform, while those of the Thompson decrease toward the end, and more particularly at the bottom of the scale.

LINE OF MOTION OF THE PENCIL.

A test to determine the line of motion of the pencil in each instrument was made, showing no errors of moment.

WEIGHTS OF THE MOVING PARTS.

All moving parts of both instruments were carefully weighed and their weights in Troy grains found to be as follows:

	Thompson.	Tabor.
Weight of 20-pound spring	338	261
Weight of 40-pound spring	497	330
Weight of piston, piston-rod, and screw at upper end	414	287
Weight of pencil-bar and attachments	39	31
Weight of back link and upper screw	45	38
Total weight of moving parts (with 20-pound spring)	841	622
Total weight of moving parts, less ½ weight of springs, back link, and radius bar (9 grains), that are supported at one end	654	472

Percentage of the Thompson over the Tabor indicator in the effective weight of its moving parts, 38.5 per cent.

TEST OF STEAM GAUGES.

At the conclusion of the foregoing tests, the steam gauges used in the work were carefully compared with the mercury column for pressures above atmosphere; for pressures below that line, the compound gauge was compared with the mercurial vacuum test gauge.

The mean reading of the Ashcroft test gauge varies from 0.45 lb. above to 1.875 lbs. below that of the column, and the compound gauge from 0.1375 lb. above to 1 lb. below. The mean variation of all the readings of the former is 0.6001 lb., and of the latter, 0.5173 lb. below that of the column.

Table II gives, numerically, the means of the six readings, taken from each indicator for each interval of pressure and for each spring tested, as found by measurement from the scales. These figures will represent very accurately the tensions of the springs under the different pressures, if the gauge used is taken as the standard.

It appears from this table that all springs of both instruments are too weak, as their scale readings are too high, excepting that of the 20-lb. spring below the atmospheric line, which is too low. The differences between the readings of the gauge and the spring are much greater in the Thompson than in the Tabor scale.

The difference between the readings of the "up" and "down" scales gives the retarding effect of the friction, or double the friction of the indicator and gauge. But, as the friction of the latter is small compared with that of the former, and is the same for both instruments, it can be neglected, and the differences taken as the double friction of the indicators.

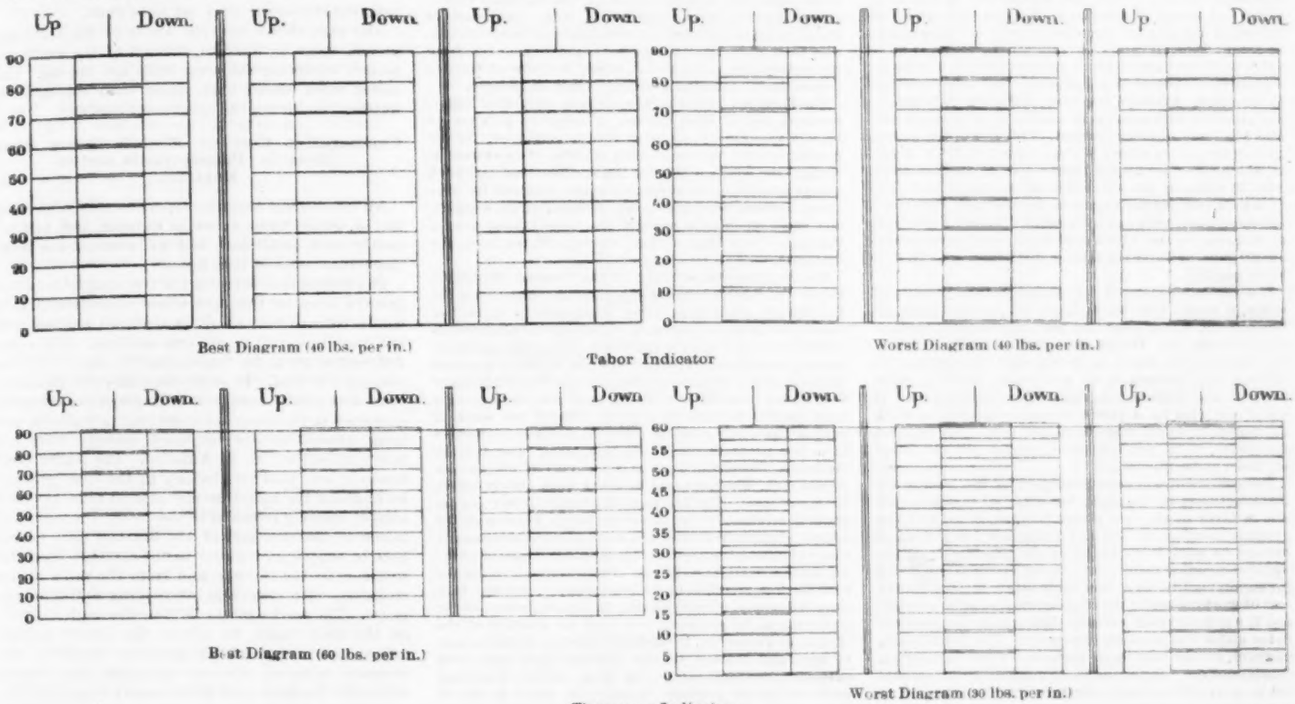
The indicated horse-powers found from cards which were taken in pairs simultaneously from the machine-shop engine with the two indicators using 20-lb. springs, were 29.09 H. P. by the Thompson against 26.98 by the Tabor, a difference of 2.01 H. P. or 7.44 per cent. The 40-lb. spring showed 29.76 against 28.66 or 1.10 H. P. (3.84 p. c.) difference.

In the absence of a standard, it cannot be determined positively which of the two instruments is the more accurate indicator of power.

The tension of the spring of the paper drum can be more easily and quickly adjusted in the Thompson than in the Tabor indicator.

The piston of the Thompson indicator fits the cylinder nearly steam tight, while that of the Tabor allows considerable steam to pass by it at the higher pressures, making it difficult to take a clean card with the instrument. The Board believed this to be a serious defect, and one that will grow with the wear of the instrument, and which will sooner or later affect its accuracy as a measure of power, to say nothing of the disagreeable effects of the escaping steam.

It appeared to the Board that the makers of the Tabor indicator, in their efforts to reduce the weight of the moving parts, had made the walls of the piston so thin that under the higher pressures they would bend in and allow steam to escape by them. A slight increase in thickness would probably remedy this defect and prevent the escape of steam past the piston.



Comparative Errors of Indicators.

The two indicators are of the same general design, and are both fitted with pencil stop, detent attachment to paper drum, guide pulleys for cord, and thumb screw for the guide pulley arm.

The pencil holder, pencil bar, links, and piston-rod connections are made of tempered steel in both instruments. The essential differences are in the means employed to give rectilinear motion to the pencil, the springs, paper drums, and in the weight of moving parts.

A jointed parallel motion is used on the Thompson indicator. The Tabor instrument has a guide pin with friction roller, on the pencil bar, working in a fixed curved guide. By giving proper curvature to the guide, perfectly rectilinear motion of the pencil can be obtained. Tests show that the rolling friction of the guide is comparatively small.

The helices of the duplex spring used in the Tabor indicator are of the same diameter and length and have their ends secured on opposite sides of the fittings, thus giving a better and firmer support to the piston than if only one spring were used.

With the top of the paper drum closed, as in the Thompson indicator, the drum is less liable to distortion; its interior is protected from dust and dirt, and greater security given to it by the support it receives from the spool spindle which passes through it.

Other things being equal, the smaller the weight of the moving parts of an indicator consistent with strength, the greater will be the accuracy and reliability of the instrument as a measure of power at different speeds, as the error due to the momentum of the moving parts will be correspondingly smaller.

CONCLUSIONS.

In general appearance and workmanship the two instruments are about the same; both can be manipulated with equal facility and diagrams drawn with them equally well.

The pencil movement is better and the range of springs of the same tension greater in the Tabor than in the Thompson instrument, in the ratio of 5 to 4.

Transportation of Petroleum in Tank Vessels.

Eighteen tank vessels, with a carrying capacity of 406,000 barrels, are now employed in the transatlantic petroleum trade. Of this total, 370,000 barrels represent the carrying capacity of steamers. Two powerful steamers and two large sailing vessels, one Belgian and the other French, have been recently added to the list. It is estimated that an oil steamer can make seven and a sailing vessel three and a half trips per annum. Even if all the tank vessels sustained this record, the annual movement would be 2,716,000 barrels, or less than half the yearly shipments of refined and crude oil and naphtha from this country to Europe. Other tank steamers, it is believed, are being constructed, some for Americans, but more for Russian investors. Attempts to gain information about the cost of operating tank steamers have proved futile. The increase in steam tonnage indicates economy in movement, and a merchant has ventured the assertion that a tank steamer can carry oil for three-fourths the cost in a sailing ship. On the other hand, a sailing vessel has no expensive machinery and no heavy coal bill. The *Oka*, a steel steamer in the Russian petroleum trade, has some notable features. She is somewhat over 300 ft. in length, and has a space between the deck and the oil cargo that can be filled with coal on the outward voyage, but is left open when the oil has been placed beneath. A partition full of water stands between the oil and the coal bunkers, and the leakage from a defective tank would thus be stopped before it got to any part of the ship where there would be danger of explosion. Space is also provided for expansion of the

oil. It has been predicted that within three years all the oil that goes to Europe will be sent by steam. This prophecy has a somewhat enthusiastic sound. Sailing vessels have a place in transportation which they will probably hold as long as there is any commerce in bulky and imperishable articles. The locomotive can outrun the horse, but it has no wish to set aside that useful quadruped, and could not if it would. In certain respects, steam is preferable to sail, but the latter is neither dead nor dying.—*Railway World.*

The Extended Use of Water Motors.*

In an article on this subject in the *Journal* for March 1 last (p. 397), I stated that a very considerable income was derived by water companies from the working of lifts in the large houses, hotels, and warehouses in the great cities and towns of America; and I may now quote the following case as a fair example of the work done in that country: Two elevators or lifts are to be fixed in an office building, each of which must travel 80 ft. vertically, and carry a load of 18 passengers. They must perform 20 complete journeys per hour, and work 10 hours per day; making 7,200 passengers carried 80 ft. high per day and the same number lowered. This is usually accomplished by placing a tank in the roof (giving 100 ft. head), to which water is pumped from a tank in the basement. The lift exhausts the water into the basement tank, and it is then pumped back again to the top tank, thus using the same water over and over again. Therefore the cost of working the two lifts would be the expense of pumping 200 galls. of water per minute 100 ft. high = 7.3 H. P. 10 hours per day.

If a gas engine is used for pumping this quantity of water, it would cost 15s. 10 d. per day, including gas, attendant, oil, waste, wear and tear, depreciation, replacement of rope, etc. If a steam-engine is used for pumping this quantity of water, it would cost 15s. per day, including coal, attendant, oil and waste, packing, wear and tear and depreciation, replacement of rope, etc. If water supplied by a power company is used to work the pump, it would cost 20s. 6d. per day. This includes the water, at 2s. per 1,000 galls., wages, oil, etc., wear and tear, and depreciation.

This statement will not be accepted by the leading lift manufacturers in England; but after all that has been said in favor of the new power companies, we find the greatest number of lifts and hoists are being fixed at present to work from tanks, or the pressure from the water companies' mains. In a recent specification issued for supplying lifts to a very large estate in London, the cost of working under varying circumstances was stated; and it was found that working direct from the pressure in the mains was the most expensive. The comparison, however, should have been made as for intermittent vs. continuous use. In the instances quoted, the lifts would not be worked four hours per day; therefore the cost of the engines, machinery for pumping, with attendance, etc., should be deducted when giving the annual cost for maintenance.

In the case of buildings where the work is intermittent and the consumption of water not great enough to warrant the putting in of special pumping plant, with its attendant costs for labor, etc., the water company's supply is the preferable plan to adopt. The lifts now running in the mansions in Park Lane, Piccadilly, and in the large offices in Pall Mall, at Charing Cross, etc., are good examples of work being done by the pressure from the mains of a water company, and also of the supply to elevated tanks for the same purpose. The water from the mains flows into the tank in the roof of the building, with a ball-cock to shut off the supply when the tank is full, the water used by the lift being wasted.

This system is capable of a wide application. Practical engineers and business men of ability have taken the matter in hand; and it is now no longer a speculation, but has proved to be highly remunerative. It would, therefore, be wise for water companies to bestir themselves before there is started in their midst a hydraulic power company, an air power company, or, as in Paris, a very profitable concern with only about 100 subscribers. There is much enterprise among the property owners in the city; and already some three or four artesian borings are being pushed forward for the supply of water to hoists, etc. Although there is room for this innovation, yet when water companies have the means at hand, and are capable of vending the water as cheaply, it is a pity that they should not avail themselves of the opportunities now constantly occurring.

Gas companies, having inaugurated the system of letting out gas stoves and gas motors, have achieved a very great success; and if water companies would follow in this direction, and advocate the use of water motors for the various purposes already indicated, and let them on hire, or even manufacture them at a reasonable rate (and it is to their interest to improve the efficiency and lower the price), an increase in their dividends must be the immediate result. Take for instance the large number of church organs used in London and its suburbs. Estimated at a very low average per motor, there is an income derivable, if the companies encouraged their use that would immediately raise the dividends of the eight companies, if taken in conjunction with motors for lifts, hoists, etc. Most of this class of business may be obtained; and for intermittent use water and gas companies can do the work cheaper than any other special power company. If the water companies would supply a simple motor, and rent it with the power, a great trade might be done, and would certainly advance the interests of the companies, whose aim should be, not only to supply a pure and wholesome water at high pressure, but also to force the companies to the front as dividend-paying concerns; and besides, the supply of power will be of incalculable service to the community at large. The Birmingham Compressed Air-Power Co. estimate that a profit can be made of £24,000 per annum. I do not infer that this cannot be done, nor that there is not ample scope, especially in Birmingham, for the company's operations; but I maintain that a very large percentage of the cases of intermittent use, which they estimate will employ their power, may be supplied at the cheaper rate from the corporation water-mains, to say nothing of the Gas Committee's capability to supply power as cheaply.

The Paris Air-Power Co's. system is altogether different from that at Birmingham. A negative pressure or partial vacuum of about 12 lbs. is employed, the air flowing inward to the central station. This system is perhaps the most suitable for Paris, where there are such a large number of very small powers required by jewellers, hatters, wood and ivory turners, cloth workers, and small machinists needing less than 1-horse power. It is stated that this company earned 100 per cent. the first year.

The great success attained by the General Hydraulic Power Co. Limited should be a sufficient incentive to the London and other large water companies to utilize the power now at their command. Of course the same results cannot be expected from the water companies, inasmuch as the pressure ranges only from 60 lbs. to 160 lbs. as stated in the monthly reports issued by the late Water Examiner for London; but there is ample scope for developing a large trade in motors, as a great number are working very satisfactorily at 40 lbs. pressure, and are productive of a fair profit to the water companies. The London Hydraulic Power Co. work at a pressure of 700 lbs. per square inch, which is equal to a tank fixed 1,600 ft. above the street level. The Liverpool Hydraulic Power Co. are about to work at 750 lbs. pressure; and in Edinburgh the scheme about to be floated will work at a similar pressure, thus exhibiting the growing needs of such means of working motors in all large towns. There is ample room for both the low pressure, or ordinary supply, and the high pressure supply, more especially in London, where all the water has to be pumped; but with the addition of the Hydraulic Power Co., Greathead's injector hydrants may be used, and London become comparatively safe from extensive conflagrations. In most of the American water-works the pressure ranges from about 40 lbs. to 60 lbs. per sq. in.; and the machines constantly running are innumerable, as may be judged from the number of motor manufactories turning out quantities of different patented inventions weekly, all of which appear to have a successful run.

The water companies, having the power at hand, with the mains already laid in every thoroughfare, ought to successfully compete with a new company, whose only income is derived from the sale of power. In many of the American water-works water power has been brought to favorably contend with steam for many purposes; this department, being pushed, is productive of great profit. It is a matter of considerable importance to a water company having an excess of water, and engine power to pump it, whether they permit the power to remain idle and not attempt to utilize it in any way; thus allowing a special company to lay new mains and monopolize that which is already within their grasp. Water companies are harassed in every way by the authorities, apparently with a view of compelling them to fail in some of their statutory duties, and to prevent a fair dividend from being earned; therefore it is opportune for companies to initiate a new department, and follow the gas companies, who are so successful in promoting the use of motors. In most cases, water companies have duplicate engines; and it is therefore surprising that such a prolific source of profit should have been so long neglected. One of the London companies has recently laid a special main for working lifts, etc., in the West End, which, when made known, will be largely sought after, if the price per 1,000 galls. is commensurate with the benefits to be derived from the use of the motors. Would it not be good policy to charge a lower rate for working lifts, motors, and other power machines? These consume large quantities, compared with the usual domestic supplies, who use it at the same pressure. It certainly would recoup the companies if they charged a less tariff than the General Hydraulic Power Company, viz.:

		Per 1,000 Galls.
Above 3,000 and not exceeding 5,000 galls.		8s. 0d.
" 5,000	" 10,000 "	7 6
" 10,000	" 20,000 "	6 0
" 20,000	" 50,000 "	5 0
" 50,000	" 100,000 "	4 0
" 100,000	" 200,000 "	3 0

If over 200,000 galls. per quarter, 2s. per 1,000 is charged. A number of water companies, pumping their supply, are making a fair profit by charging 1s. per 1,000 galls., for *all* quantities; and other companies, obtaining their supply by gravitation works, charge from 3d. to 9d. per 1,000 galls. In such cases where the water-works are owned by a company, the price should be governed by the quantity used; the greater the quantity used, the lower would be the price charged. The greater consumer, of course, will demand the lower rate, as per present scale.

*By J. T. RODDA, in Journal of Gas Lighting, Water Supply, etc., England.

Progress on the Forth Bridge.

The accompanying progress plan, taken from *The Engineer*, shows the status of work on the Forth bridge on Dec. 12, 1888. The black, or nearly black, represents the finished work; the dotted portion is work erected, but not completely riveted: the remainder shows the work yet to be done.

The plan shows that the whole of the north approach work is finished, and all of the south approach excepting the wing-walls and coping. The metal work shows that more than one-third is finished, including the permanent roadway.

Comparative Cost of Manufacturing Steel Rails in Pennsylvania and in England.

An interesting consular report on this subject by Mr. J. SCHOENHOF, dated in October, 1888, has recently been published, and we abstract the more important parts of it as follows:

The differences between the two countries in the price of labor on the spot where manufacturing is conducted are very small in steel-rail making, and not very material in pig-iron making. The main differences are in the transportation expenses of the ore, coke or coal. In both countries the Bessemer process is mostly used, but in England the hematite ores used in the process are getting very scarce, and large quantities are imported (chiefly from the north of Spain), as in America. The native ores, however, are used very largely in the basic process. In England the manufacture of steel rails has been almost entirely removed to the coast; the transportation of the ores and of the finished rails for export is, therefore, reduced to one carriage from the steamers to the furnace, and from the mills to the steamers, with very little intervening additional expense. The works in the Middlesborough district, on the west coast, to which the report mainly refers, are very advantageously situated, the steamers lying at wharves alongside the works, while the Durham coal-fields supply coke at a comparatively small transportation expense (48 to 72 cts., according to distance), and the native ores for basic steel are not far distant. In the Cleveland district the ore is of a soft nature and is easily mined; it is of 31 to 32 per cent. The mining is both surface and by shaft, and a miner can easily get out 5 tons per day of 8 hours, or 6 to 7 tons in very rich seam; for this he gets 20 cts. per ton, and as the work is regular, he may average 96 cts. per day all the year round; in bad times, there are only 4 or 5 days' work per week. The differences in the labor cost of pig-iron making are caused principally by the quality of the ore, the richer ores requiring less wheeling, etc., to the ton of pig-iron. The coke costs in Durham, put on cars, $1.94 per ton; transportation to Middlesborough averages ¾, or 60 cts. per ton; total, $2.54.

The cost of pig-iron is given as follows:

Cost of Cleveland Iron used for Basic Steel.

3 1-4 tons of ore, at 96 cts.	$3.14
1 1-10 tons of coke, at $2.55	2.80
3-5 ton of limestone, at 84 cts.	.49
Labor	.97
Wear and tear, repairing, stores, etc.	.48
Office expenses, etc.	.12
Total	$8.00

Cost of Iron for Bessemer Rails.

(The iron is of Spanish ore of 50 per cent., brought from Bilboa. Cost, $1.68; freight, $1.00; total, $3.28 per ton).

2 tons of Bilboa ore, at $3.28	$6.56
1 ton of coke, at $2.55	2.55
2-5 ton of limestone, at 84 cts.	.33
Labor	.79
Wear and tear, etc.	.48
Office expenses, etc	.12
Total	$10.83

The four furnaces of one firm averaged the following output per week in 1887: Cleveland iron, 665 and 507 tons = 1,172 tons; and in two furnaces, hematite iron, 836⅓ tons. Total, 2,008⅓ tons, at a cost in labor equal to 85 cts. per ton. Some English engineers and furnace owners are not in favor of the

American system of a very large output per furnace. "The original plant costs the same relatively whether two small furnaces or one large one; the number of men is the same per ton, and is regulated by the output. The high rate to which the American furnaces are put is a heavy wear and tear on them." The engineer quoted had recently blown out a furnace which had needed no relining for 16 years, while the large furnaces in America need relining every 2 years. Each of his furnaces had made during that period nearly 400,000 tons of iron, which, at 25 cts. per ton, would have more than paid itself. He stated from his own observation that men work much harder here than in England.

The American furnaces considered are owned by the company manufacturing steel rails; there are 8 furnaces with an output of 3,000 tons per week, and the works are well equipped with modern improvements and are well managed. The company makes the greater part of its own iron, and uses about 30 per cent. of Cornwall iron in its output of steel rails. For the iron, Cuban and European ore of 58 per cent. is used. The cost of ore per ton of pig-iron is $11, or, at 58 per cent., $6.38 per ton at the furnace, against $2.90 of the same percentage of iron in the ore at Middlesborough; 75 cts. duty added would still leave $2.73 to be accounted for as covering the freight surplus charge from Bilboa or North Africa to Philadelphia over freight cost to Middlesborough and the inland transportation from tide-water to the furnace, about 80 miles. The fuel is 75 per cent. coke, and 25 per cent. anthracite coal; the former costs about $4.50 and the latter $2.85 per ton, delivered at the works. The difference would be in the transportation expense, which would seem rather a high rate; coke, however, has been sold as low as 90 cts. per ton at the ovens, and even at the higher price is cheaper at the place of manufacture than at the ovens at Durham, where the English coke is obtained.

Very interesting details are given of the cost of coal mining and coking. The cost of mining is considerably less than in England, and the cost of coke is shown as follows:

Cost of Coke.

	Connellsville.		Durham
	Short Ton	Long Ton	
Average cost of coal to ton of coke	$0.607	$0.673	$1.08
Average royalty	.16	.1776	.23
Labor at ovens, supplies and repairs	.405	.45	.48
Total	$1.172	$1.3006	$1.79

The furnaces in America (eastern Pennsylvania) which are taken as an example are worked by two shifts of 12 hours each, each shift being composed of 16 men, or 256 men for the 8 furnaces for 24 hours; at 3,000 tons weekly output, this gives 11.72 tons per man. The bosses are paid $1.65 to $1.75 per day, furnace men $1.30, ordinary laborers $1.16; the average wages being $1.30 per day, or $9.10 per man per week. The cost of furnace work per ton of pig-iron is, therefore, obtained as follows:

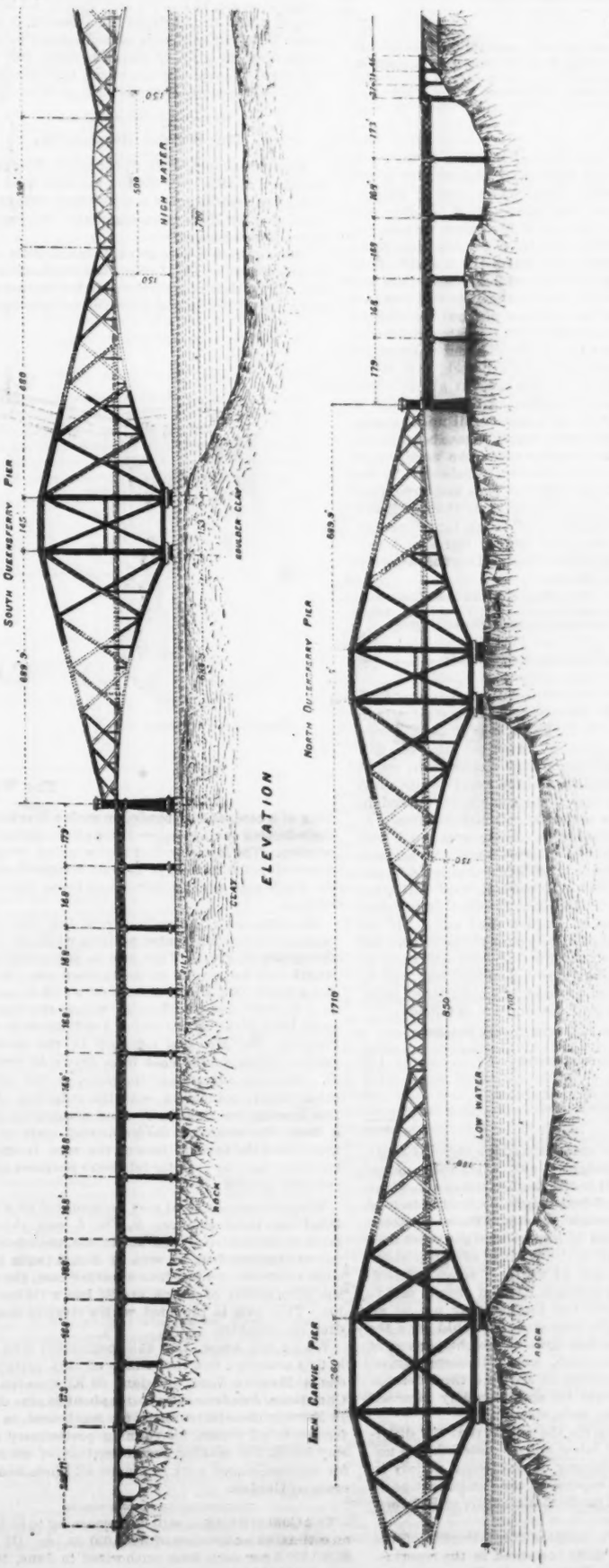
$$256 \times \$9.10 = \frac{\$2,329.60}{3,000} = 77.65 \text{ cts.}$$

The following table shows the cost for Bessemer pig-iron in eastern Pennsylvania, made of Spanish and Cuban ores, compared with English iron of the same class, and it will be seen that the only marked differences are in the ore and fuel accounts:

Cost of Pig-Iron for Bessemer Steel.

	Eastern Pennsylvania.	Middlesborough.
Ore	$11.00	$6.56
Limestone	.40	.33
Fuel	4.50	2.55
Labor	1.25	.79
General expenses	.12	.12
Sundries	.50	.48
Total	$17.77	$10.83

The steel mill in England, from which the account of the cost of manufacturing Bessemer steel rails is taken, works in shifts of 12 hours; they make 40 charges per day, have 2 converters and turn out 7 to 8 tons in each heat. There are 600 men employed and the weekly output is 1,500 tons. The cost of labor per ton is as follows;



The Forth Bridge; Showing Progress to Dec. 12, 1888.

Cost of Labor in England.

Labor in converting	$0.85
Labor in rail making from the ingots	1.94
Additional labor	.24
Total	$3.03

The total cost of manufacture per ton is as follows:

Cost of Manufacturing Bessemer Steel Rails in England.

1 1-10 tons of hematite iron at $11.26 per ton	$12.38
168 lbs. of spiegeleisen iron at about $20.00 per ton	1.44
1568 lbs. of coal at $1.80 per ton	1.26
Labor	3.07
Total	$18.15

The price of steel rails at the time of the report was barely enough to cover the charges, and left no margin for profit. The wages are as follows: smiths, enginemen, and joiners, $1.22 per day; men at the rolls and furnaces, $1.70; fitters, turners, roll turners, and bricklayers, $1.34; outside men, 97 cts.

The English mill from which the account of the cost of the manufacture of basic steel rails was taken was one of the best in the district. The iron used in this steel is Cleveland pig, but the cheaper price per ton is balanced by the greater amount of iron required for a ton of rails. About 800 men are employed, and are paid $6,276 per week, or $7.84 per day, or $2.62 per ton. In the account given below, the labor items of bricklaying, etc., contained in the labor account of the hematite rail mill, are contained in the additionals, the difference being 13 cts. more than for the Bessemer rails; the greater part of the extra amount, however, is balanced by the credit deduction for value of ends and defectives. The additionals are higher in basic than in Bessemer steel, and include royalty, lime, limestone, tar, refractories, castings, and sundry stores and purchases for maintenance. The total cost of manufacture per ton is as follows

Cost of Manufacturing Basic Steel Rails in England.

1.3110 tons of pig-iron at $8.10	$10.62
0.1410 tons of ferro-manganese (spiegeleisen) hematite	2.40
Fuel	1.30
Labor (converting, $1.05; rail making, $1.44)	2.49
Additionals	2.16
Total	$18.97

The inquiry into the cost of making steel rails in America was made in 1887, a year of high prices, steel rails ranging from $40 to $32 per ton. The mill (in eastern Pennsylvania) had 4 converters, only 3 of which were working, and the weekly output was 4,500 tons. The men at the converters worked in 3 shifts of 8 hours each, the rail-making employés in 2 shifts of 12 hours each. There were in all 1,048 men employed in the steel works, and the pay roll for the month was about $57,000; this is $54.38 per man per month, and at 25 working days $2.17⅓ per day and $13.05 per week, about two-thirds more than the average wages in English steel mills. If we divide the amount of money paid for labor over the output, however, we shall find no such difference to exist as these higher earnings might lead one to suppose. The details of cost of 1 ton of steel rails, as taken from the mill account, are as follows:

Cost of Manufacture of Steel Rails in Pennsylvania.

1 ton of pig iron	$18.00
3 hundred-weight of spiegeleisen	4.00
Fuel	2.00
Labor	3.04
Sundries	.50
Additional labor (unexplained)	.84
Total	$28.38

At $27 per ton for spiegeleisen, the above $4 represents 3 hundred-weight (1 cwt. = 112 lbs.) against 1⅓ hundred-weight in the English statement, which is balanced by 1 hundred-weight more of iron used in the Middlesborough account. There is, therefore, in this account ⅓ hundred-weight more used than in the English mill. With $3 of spiegeleisen, 1 1-20 tons of iron and $2 worth of scrap are used, and with $4 of spiegeleisen, 1 ton of iron is said to be sufficient. While the English only use in all 1.175 tons of weight, this account would give the American practice 1.30 tons of weight per ton of rails, which, it is stated, would, if correct, need further explanation; but at any rate, the difference in the weight would be approximately returned in the value of scrap, ends, etc.

The report shows, on the whole, that the differences in the cost of labor and of materials are not very great; the difference of cost being mainly in the transportation expense of the component parts of the pig-iron used in the manufacture of Bessemer steel.

The following is a comparative statement of the output of the two mills instanced in the report:—Steel mill in eastern Pennsylvania, Bessemer steel rails turned out per week, 4,500 tons; total number of men employed, 1,048; output per man, 4.3 tons; average wages, $2.17⅓ per day; cost of all labor employed in the mill, $3.04 per ton. Steel mill in England: Bessemer steel rails turned out per week, 1,500 tons; total number of men employed, 600; output per man, 2.5 tons; average wages, $1.33 per day; cost of all labor employed in the mill, $2.80 to $3.80 per ton.

The Wredes Hand-Level.

We are indebted to Mr. WOLCOTT C. FOSTER, civil engineer, of this city, for the material used in the following description of a convenient form of hand-level used by Norwegian engineers, but seemingly novel in this country:

The illustration here given is made from the instrument itself. Fig. 1 shows the level adjusted for use. It consists of a narrow, vertical mirror *A* covering one of the lateral halves of an opening in the back of a case, and suspended in such a manner that the reflecting surface passes through the axis of suspension. The lower part of the swinging frame *B* containing the mirror, is heavily weighted so that the whole acts as a pendulum and keeps the mirror vertical.

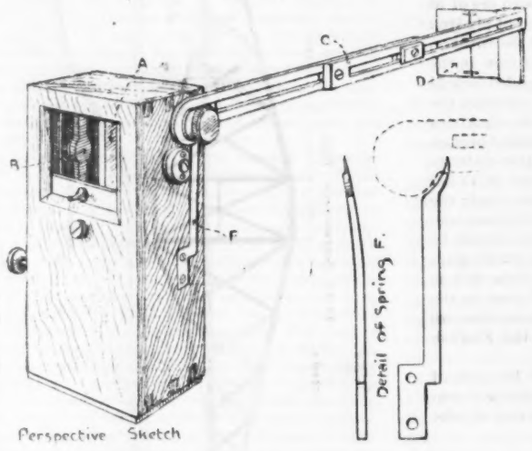


Fig. 1

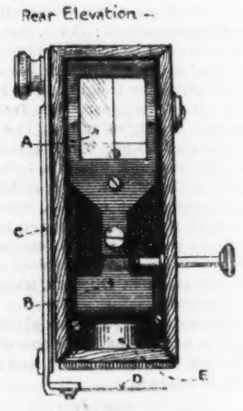


Fig. 3.

Fig. 2.

The Wredes Hand-Level.

The long arm *C*, extending from the side of the case, is held in horizontal position while in use by the spring *F*, Fig. 3. This arm is adjustable as to length and has a scale on the further side. It carries a small card *D*, the middle of which is pierced by a minute opening, through which the observer looks both at the mirror and at a rod placed at some distance. He also sees reflected in the mirror a number of horizontal black lines drawn on the card *D*. When in adjustment the point on the rod, or other object, coinciding with the reflection of the line crossing the sight-hole, must necessarily be on a level. By means of the graduated scale on the arm *C* and the various lines on the card *D* the instrument may be used for telemeter purposes or for running grades.

While in use, the level may be mounted on a staff fitted into the hollow cap *E*, Fig. 2, and thus be made more steady. When not in use, the whole affair can be folded up as seen in Fig. 2 (with front slide removed) and put into a leather case, the outside dimensions of which are 2½ ins. x 1⅝ ins. x 5 ins. This case is provided with a strap to sling it over the shoulder.

We do not know that this instrument is on sale in this country; but the maker of this particular one is MARTIN VIIG, optician, 30 Kirkegaden St., Christiana, Sweden. The cost is about $6 plus duty. In Norway these instruments are much used, in preference to all others, for running preliminary railway levels, for making profile sections of country, for reconnoissance work of almost all kinds, and for cross-sectioning.

THE CORINTH CANAL still has remaining to be done an estimated excavation of 3,917,000 cu. m. Of the $6,000,000 6 per cent. loan, authorized in June, 1887, only $2,000,000 has been taken up.

The Identification of Dry Steam.*

This paper describes observations on steam flowing from small orifices in insulated pipes, the quality of the steam being measured by condensing it, and noting the amount of heat imparted to the condensing water. Steam which was slightly superheated or dry was transparent close to the discharge orifice, while moist steam issued as white mist. Mr. DENTON concludes that

"1. It appears from the preceding investigation that jets of steam show unmistakable change of appearance to the eye when steam varies less than 1 per cent. from the conditions of saturation either in the direction of wetness or superheating.

"2. It appears from the investigation following in Part 2 that the instrumental error of portable condensing calorimeters does not theoretically interfere with the measurement of about 1 per cent. of variation in the heat of saturated steam; but in the use of such calorimeters there has always been found to exist an accidental variation or error considerably in excess of the theoretical instrumental error, even REGNAULT'S magnificent work not being an exception in this respect. Consequently, if a jet of steam flows from a boiler under circumstances such that very little loss of heat occurs through radiation, etc., and the jet be transparent close to the orifice, or be even of a greyish white color, the steam may be assumed to be so nearly dry that no portable condensing calorimeter will be capable of measuring the amount of water steam. If the jet be strongly white, the amount of water may be roughly judged up to about 2 per cent., but beyond this a calorimeter only can determine the exact amount of moisture.

"3. A common brass pet cock may be used as an orifice, but it should, if possible, be set into the steam drum of the boiler and never be placed farther away from the latter than 4 ft., and then only when the intermediate reservoir or pipe is well covered."

So much has been written for and against the reliability of experiments made with the ordinary barrel calorimeter for determining the quality of steam that the second part of Mr. DENTON'S paper, discussing the effects of errors of observation, is of peculiar interest. It is gratifying to find that the practice of the majority of engineers is justified by the mathematical discussion from which the following conclusions are drawn:

"1. That for weights of condensing water from 300 to 5 lbs., and weights of condensed steam from 25 to ⅛ lb., the instrumental errors cannot give rise to discrepancies in duplicate tests greater than 2¾ per cent., and the probable error is about one-half per cent., provided that temperatures are determined to 1-10 degree Fahrenheit, steam pressures to 3 lb. per sq. in., weight of condensing water to 1-100 lb., and weights of condensed steam to ⅛ per cent., *and that the weight of condensing water is not more than 13 times the weight*

* Abstract of paper read by Prof. DENTON at the Scranton meeting of the Society of Mechanical Engineers October, 1888.

of steam condensed, or the range of temperature not less than 85°.

"2. That for the above conditions the magnitude of the several partial errors is as follows:

Error due to weight of condensed steam		+ 0.35
" " initial temperature of water		+ 0.15
" " final "		− 0.32
" " weight of condensing water		− 0.06
" " steam pressure		+ 0.24

"3. As the ratio of the weight of condensing water to the weight of steam condensed exceeds 13 to 1, the errors due to the temperature are proportionately increased, all other errors remaining sensibly constant.

"*Consequently the lower the range of temperature in the calorimeter the greater the error, for example, for a range of* 5°, the condensing water must be 239 times the steam condensed, and the errors of final and initial temperatures would be $\frac{239}{13} = 18$ times the amount in 2. *The most general law is therefore that the total error is a minimum when the range of temperature in the calorimeter is greatest.*"

Theoretical and Practical Efficiency of Steam at High Pressures.*

In dealing with questions concerning the efficiency of the steam engine, it is usual to include the history of the steam after it leaves the steam-engine cylinder. Inasmuch, however, as it is only that portion of its history which the steam spends in the cylinder, up to the period of exhaust, that admits of material modification, it is only that part which will now be considered.

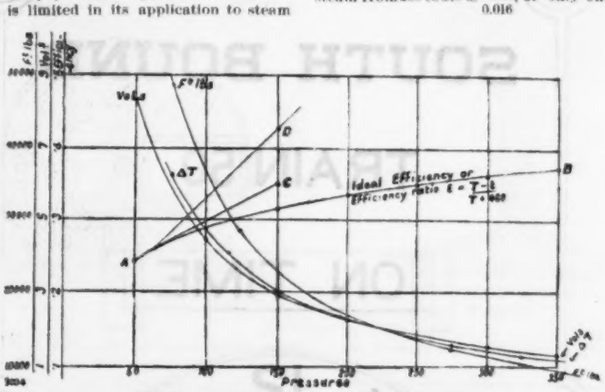
The object of this paper is, firstly, to show that the CARNOT theorem is limited in its application to steam engine calculations of efficiency; and, secondly, to show that high-pressure steam must theoretically, as well as practically, be more efficient than low-pressure steam. For some time it has been increasingly evident that the behavior of steam in a steam-engine cylinder cannot be interpreted by laws that are true for a permanent gas, and that the actual efficiency of its action is not proportional to the range of temperature used in the cylinder. It has, on the contrary, become evident that the practical efficiency is much more nearly inversely proportional to the range of temperature in the cylinder; and, moreover, it has become increasingly evident that the efficiency of the actual steam engine cannot be usefully measured by any standard based on the CARNOT theory of the perfect engine, as expressed by the relation $E = \frac{T-t}{T}$. That is to say, the relation which the range of temperature bears to the absolute temperature is not an index of efficiency.

Modern practice has amply proved that the real efficiency of the steam engine has only been increased in proportion as the special character of the working fluid has been studied and provided for. The CARNOT theorem ignores the nature of the working fluid, and the endeavor to realize with steam the conditions of a CARNOT engine has led to delay in the development of the steam engine.

It has now been demonstrated, both experimentally and on the largest practical scale, that the most efficient working is obtained with steam when it is used so that the range of temperature in one cylinder is small.† The expansive energy of steam at a high pressure can therefore be only utilized by expansion in several stages—that is to say, by passing it from one cylinder to another until the minimum working temperature or pressure is reached. The number of cylinders so required has been found to depend chiefly upon the maximum range of pressure economically permissible in each cylinder. By augmenting the number of stages of expansion, steam pressure has been usefully increased to about 180 lbs. per sq. in., instead of about 75 lbs., which, with the simple engine, was found to give results little, if at all, inferior to those obtained with a higher pressure.

Formerly it was commonly assumed, chiefly as a deduction from CARNOT'S theorem, that there could be little gain as a result of the use of high-pressure steam, because the thermal value increased so slowly as compared with the increase in pressure. Upon the same grounds it is now generally held that the present state of our knowledge indicates that a pressure of about 200 lbs. will give results equal to those which are possible with any higher pressure. This argument is in strict accordance with the CARNOT function already mentioned, and it is this argument which I propose to show is not necessarily a true one.

On the diagram, Fig. 1, is a curve *A B*, which shows, according to CARNOT'S theorem, the ideal efficiency of the steam engine as a heat engine using steam at pressures of from 50 to 350 lbs. as marked along the abscisse. From this it will be seen that the rate of increase of efficiency rapidly falls as the pressures increase. The temperature of steam at 50 lbs. pressure absolute being 281°, and taking 100° as the lower temperature, or that of the steam-engine condenser, the efficiency ratio $E = \frac{T-t}{T} =$ $\frac{281-100}{281+460} = \frac{181}{741} = 0.242$. At 100 lbs. $E = 0.29$. This gives an ideal increase in efficiency of 0.048 for steam at 100 lbs. as compared with steam at 50 lbs. At 200 lbs. the efficiency ratio is 0.333, and at 250 lbs. $E = 0.349$. Thus the difference in the ideal efficiency as between 200 lbs. and 250 lbs. is only 0.016, so that according to CARNOT the increase of efficiency attendant upon increasing the pressure of steam from 200 to 250 is $\frac{0.048}{0.016}$, or only one-third as much as for the 50 lbs. increase from 50 lbs. to 100 lbs. An increase in pressure from 300 lbs. to 350 lbs. gives an increase in efficiency measured in this way of only 0.01, or less than one-fourth that from 50 lbs. to 100 lbs. Thus, according to the CARNOT theorem, the gain attending the use of pressures above about 150 lbs. could not, it has been assumed, be sufficient to counterbalance the practical disadvantages incurred. Experience has proved that this is the reverse of the truth. Every increase in pressure has secured an increase in actual efficiency, which has been far more than is necessary to cover the increased cost of obtaining it. The rate of increase has been double that which the CARNOT theorem indicates, and it has been amply shown that the engines made for and supplied with steam at a high pressure work under conditions which are much more nearly those required for maximum efficiency than do those engines which work with the lower pressure.



Efficiency of Steam at High Pressure.

From the curve, Fig. 1, it will be seen that by raising the steam pressure from 65 lbs. to 150 lbs., the efficiency ought to be increased by 21 per cent., or that a saving of 17 per cent. ought to be made. As a matter of fact, a saving of from 20 to more than 30 per cent. has been achieved, or an increase in efficiency as measured on the CARNOT diagram of from 25 to 43 per cent. Taking 25 per cent. economy, and for convenience of comparison starting from the Carnot curve at 65 lbs., the actual efficiency above that which is obtained when 65 lbs. steam is used reaches 33 per cent., or the height shown by the point *C*. Taking 30 per cent. as the saving, the relative actual efficiency reaches the point *D*.

It is clear, then, either that the high-pressure engine is remarkably efficient, or that the low-pressure simple engine is remarkably inefficient. No explanation has yet been given of the cause of the great difference; but it is the object of this paper to show that there are fundamental reasons for it which have hitherto been overlooked. Steam can only be varied in the efficiency of its employment by variation of the conditions which affect the advantageous utilization of its expansive energy. Now as the total heat of a volume of steam, say 1 lb., is within a few units as great expansion as before it, nearly all the fall in the quantity of heat takes place when the steam leaves the steam-engine cylinder. To compare, then, the relative values of steam used expansively at low and at high pressures, it is desirable to examine the relative conditions of expansion through a given range of pressure before exhaust occurs, as, for instance, from 100 lbs. to 50 lbs., or 200 lbs. to 150 lbs.

A pound of steam at a pressure of 350 lbs. per sq. in. and a temperature of 432° Fahr., or 892° absolute, has a volume of 1.35 cu. ft. A pound of steam at 300 lbs. and a temperature of 417° Fahr.—877° absolute—has a volume of 1.565 cu. ft. Assuming the pound of steam at 350 lbs. pressure to have expanded down to a pressure of 300 lbs., it will have fallen in temperature 15°. The mean pressure during the expansion from volume 1.35 to volume 1.565 will be 343 lbs, and this pressure, acting through the range of expansion of 0.215 ft., represents 10,372 ft. lbs.* The work done by expansion per degree fall in temperature is thus 691 ft. lbs. Again, 1 lb. of steam at 300 lbs. expanding from its volume of 1.565 to 1.853 and 250 lbs. pressure falls in temperature 16°; while the mean pressure during the fall will be 295 lbs. representing through the range of expansion 0.288 ft.—12,235 ft.-lbs.—or 765 ft.-lbs. per degree fall in temperature.

Following the pressures, temperatures, and volumes, in the same way, of the pound of steam in expanding from 250 lbs. to 200 lbs., it appears that between these two the fall in temperature is 19.5°, the expansion work represents 15,170 ft.-lbs. or equal to 773 ft.-lbs. per degree fall in temperature. Between steam at 100 lbs. and at 50 lbs. there is a difference of temperature of 46.8°, and the work represented by the expansion of the steam from one volume to the other is 49,280 ft.-lbs., so that the expansion work per degree fall in temperature is 1,053 ft.-lbs. There is thus per degree fall in temperature of steam expanding from 350 lbs. and from 100 lbs. respectively, a difference of 1053 − 691 = 362 ft.-lbs. of work done. The expansion work done by steam between 100 lbs. and 50 lbs. pressure is then apparently $\frac{362}{691} = .52$, or 52 per cent. greater per degree fall in temperature than with steam expanding from 350 to 300. These figures are given in column 12 of the appended table, and from them it can be readily seen how far is the departure from proportionality between fall in temperature and work done during expansion.

Plotting a curve with the differences of temperature, $\triangle T$, for ordinates, but increasing the value of the ordinates by a constant quantity so as to place the curve in a position for ready comparison with a curve of foot-pounds of work done by the expansion in volume, we have the curve marked $\triangle T$.

In all cases, then, it will be seen that the quantity of work represented by expansion from one pressure to another at high pressures, is more nearly that represented by fall in temperature or loss of heat than at low pressures. It will be seen, therefore, if heat disappears in proportion to the work done, that the low-pressure-engine cylinder for a given range of pressure must require more heat—either from a steam jacket, or from liquefied steam entering the cylinder during the admission part of the stroke,—than the high-pressure cylinder.

These considerations help to show wherein lies the great advantages that arise from the use of high-pressure and multiple stage expansion. With the exception of a very small quantity, a steam engine gives up in its exhaust steam nearly all the heat that the steam contained on entering.

By increasing the pressures used, an extra number of stages of expansion may be obtained at small expenditure of heat in the boiler. The difference between the total heat of steam $\triangle H$ at 300 lbs. and at 250 lbs. is under 5 units, but the work done by expansion from 300 lbs. to 250 lbs. is about 12,240 ft.-lbs., or about 2,400 ft.-lbs. per unit of heat employed in raising the pressure. The work done per unit of heat disappearing on expansion for each stage of 50 lbs. is given in column 11.

By adopting high pressures and short stages of expansion, the arrival of the evil time of exhaust is delayed, and the method of delay is of the greatest importance. With a small range of expansion, not only is fall in the temperature on the working side of the piston kept down, but the temperature on the opposite side of the piston is kept up; so that the difference in temperature on the opposite sides of the piston is small. The new steam, in fact, expands in a warm cylinder kept warm under conditions which involve no loss.

The conclusions to which the foregoing leads, although this paper is only a preliminary consideration of the subject as put forth, are:

1. That the work done with steam in a steam engine cylinder is not proportional to the range in temperature.

2. That steam pressures much above 200 lbs. on the square inch may be used with advantage.

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* Paper read before Section G of the British Association by Mr. W. W. BEAUMONT, M. Inst. C. E.

†See, for instance, WILANS on "Non-Condensing Steam Engine Trials," Proc. Inst. C. E., vol. xciii.

* The volumes taken are those of saturated steam at the pressures given. Mean pressure between these has been assumed to follow a hyperbolic curve. This curve between two near points will be practically identical with the saturation curve, and the mean pressure given will not be inaccurate from this cause.

3. That a small range of pressure should be used in each cylinder.

4. That the number of cylinders should be as large as mechanical considerations will allow.

5. That the economy obtained by multiple-stage expansion engines, as compared with single-stage expansion, is due to the small difference of temperature in a cylinder on the opposite sides of its pistons; to the opportunity which the protracted working history of the steam gives for the utilizable re-evaporation of the steam which is condensed in providing the difference between the heat represented by work done during expansion, and the heat which corresponds to the change in volume; and to the large quantity of work done during expansion at high pressures per unit of difference in the heat required to raise steam at a high or at a higher pressure.

Efficiency of Steam at High Pressures.

	1. Total Pressure	2. Temperature T	3. Difference in Temperatures $\triangle T$	4. Volume Cubic Feet	5. Difference in Volumes $\triangle V = V^1$	6. Ratio of Expansion $\frac{V^1}{V} = R$	7. Work Done During Expansion.	8. Efficiency $E = \frac{T - t}{T}$	9. Difference in Efficiencies $= \triangle E$	10. Work Done by Expansion per 1 deg. Fall in T.	11. Col. 7 / $\triangle$H
1	50	281		8.354				0.242			
			46.8		3.98	1.91	49,280		0.048	1053	3460
2	100	327.8		4.377				0 290			
			30.5		1 389	1.46	28,000		0.025	918	2908
3	150	358.3		2.988				0.315			
			23.3		0.706	1.33	19,454		0.018	835	2714
4	200	381.5		2.282				0.333			
			19.5		0.429	1,25	15,080		0.016	773	2605
5	250	401.0		1.853				0.349			
			16.0		0.288	1.20	12,240		0.013	765	2458
6	300	417.0		1.565				0.362			
			15.0		0.210	1.16	10,372		0.010	691	2330
7	350	432.0		1.35				0.372			

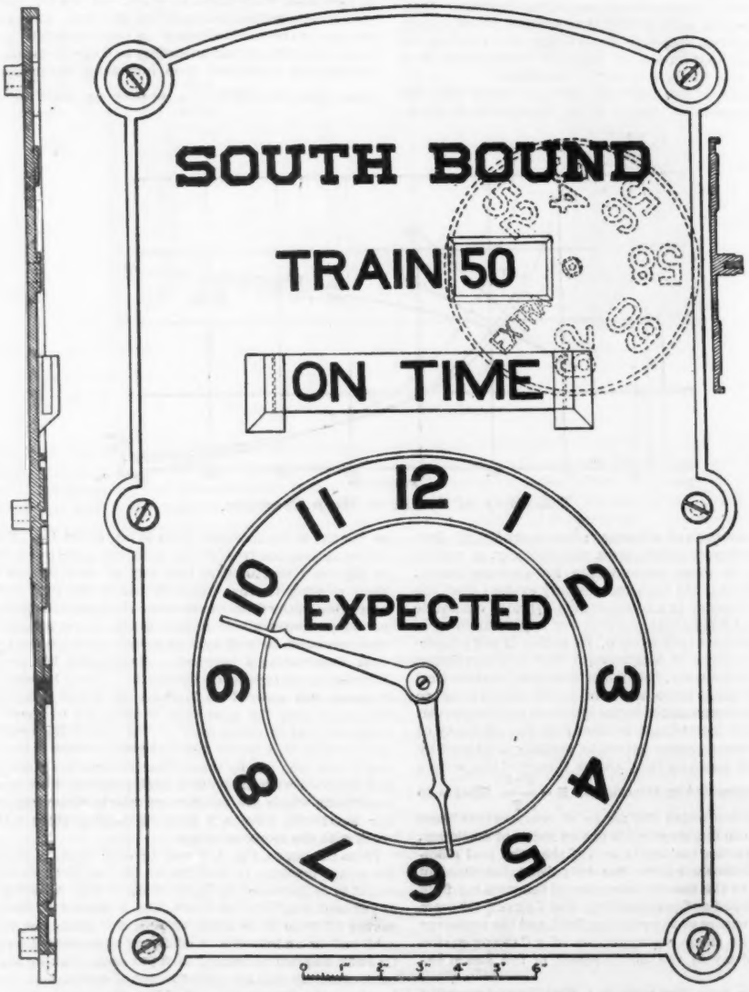
BRICK FOUNDATIONS.—Mr. H. LEONARD, M. I. C. E., the late chief engineer to the Bengal Public Works Department, gives in *Indian Engineering* an interesting account of experiments carried out by him at Akra with a view to determining the proper proportions of brick foundations in alluvial soil. The experiments were made on a large scale, the piers being of a size such as might be used in real work, and the indications obtained are correspondingly valuable. First, with regard to the pressure permissible, Mr. LEONARD found that with a pressure of one ton per sq. ft. on the soil there was practically no sinking, while with two tons the sinking was decided, and sufficient to cause bad cracks. If one part of a building were built with a pressure of two tons per sq. ft. on the foundations, and another part with one ton only, the unequal settlement would be, he considers, quite sufficient to cause bad cracks; Hence, the load on the foundations should be under one ton per sq. ft. or if over, should be equal on all the piers. Experiments were next made on the proper depth for the foundations. Trials were made with foundations at 2 ft. 6. in., or just below the usually disturbed soil, at 4 ft., where the true alluvial deposit was undisturbed, at 8 ft., where a different though not better soil was touched, and at 11 ft., where the soil was soft and wet. The foundations at 2 ft. 6 in. were found to be affected by heavy rains, while those at 11 ft. sank more than those at 4 ft. and 8 ft., and Mr. LEONARD finally concludes that in undisturbed alluvial soil the foundations of important buildings should be laid at a depth of between 4 ft. and 6 ft. The third point examined was the proper spread to give the brickwork in such soil, and from these experiments he concludes that for a pressure of one ton to the sq. ft. in Bengal soil the thickness at the toe of the slope should not be less than 1 ft. 6 in. and the stepping at an angle of not more than 45°.—*Engineering.*

A LOWER MISSISSIPPI RIVER BRIDGE, from some joint in Jefferson Parish, La., has been chartered. The New Orleans *Democrat* says that the project has been brought to its present stage through the instrumentality of Mr. E. L. CORTHELL, C. E., acting in the interest of Messrs. C. P. HUNTINGTON, JAY GOULD and others interested in the crossing of the Mississippi river at this point. The corporation is known as the Southern Bridge & Railway Co. and is chartered for 99 years under the laws of Louisiana, with a capital stock of $1,000,000. Messrs. CORTHELL, FARRER, BALDWIN, SMITH, SINNOTT, SCHREIBER and SORIA constitute the first Board of Directors.

Standard Train Indicator; Richmond & Danville R. R. System.

The cut here given is reproduced from a full-size drawing kindly furnished this journal by Mr. CHANNING M. BOLTON, Chief Engineer of the Richmond & Danville Railroad Co., and is the standard for train indicators on that system.

While the cut explains itself, it may be said that the indicator is an iron casting with the permanen lettering raised on the surface. There are of course two such indicators, one for the south-bound and another for north-bound trains, with proper openings for the train number and the words "on time" or "delayed," as the case may be. The two conditions last named are on opposite sides of the same slide. The train disc, shown in dotted lines, is turned to expose the proper number by a brass thumb-screw fitting over a square head on the back of the disc. The whole arrangement is neat in appearance and simple in construction, and will serve as an excellent model for standard indicators elsewhere.



Standard Train Indicator; Richmond & Danville Railroad System.
CHANNING M. BOLTON, *Chief Engineer.*

Tests of the Boyden Power Brake.

The following table giving the results of the tests of the new Boyden brake which were recently made on the Baltimore & Ohio, should have been printed in connection with the article describing the tests in last week's issue, but was accidentally omitted in making up the pages. We insert it herewith, and for explanation and comments thereon, would refer our readers to page 95 of the issue of last week.

Brake tests made on the Baltimore & Ohio Railway, of the Boyden Power Brake, Dec. 17, 18, 19, 1888.

No. of Test.	Cars in train.	Length of train, ft.	Weight of train, tons.	Grade, ft. per mile.	Speed, miles per hour.	Time of stop, seconds.	Distance, ft.	Vel. head.	Computed efficiency of brake in p. c. of wt. of entire train.
1	37	1100	589.5	des. 80	39	24	920	54.00	6.87
2*	37*	1045	507.5	" 80	35	21½	930	43.40	5.73*
3	37	1100	589.5	asc. 23	24	13½	250	20.46	7.35
4	36	1063	571.3	" 10	31	15	360	34.12	8.87
5	36	1063	571.3	des. 53	33	14	550	38.66	7.70
6	36	1063	571.3	" 15	37	15	588	48.00	8.17
7	36	1063	571.3	Level.	42	16	615	62.62	9.48
8	36	1063	571.3	des. 116	32	17	630	36.35	7.57
9	36	1063	571.3	" 116	47	20	905	78.42	9.63
10*	36*	1008	489.3	" 116	28	14	500	27.83	7.37*
11	24	943	518.8	" 106	45	—	963	71.89	8.76
12	11	508	298.3	" 92	32	15	468	36.35	9.01
13	11	508	298.3	" 116	34	25	883	41.04	6.35
14	11	508	298.3	" 116	36	24	821	46.01	7.31
15	11	508	298.3	" 26	50	22	1023	88.75	8.29

* Engine cut loose in tests No. 2 and 10. Train stopped by car brakes only.

Cylindrical Wheels and Flat-Topped Rails.

The following is a full abstract of the highly interesting paper read by Mr. DON J. WHITTEMORE, Chief Engineer C. M. & St. P. Ry., at the last annual meeting of the American Society of Civil Engineers. It is in the nature of a discussion of the recent report of the "Committee on the Proper Relation to each other of the sections of Railway Wheels and Rails," although covering much ground not entered into in that report. We forbear discussion until we are able to publish the whole of our abstract, which we cannot do this week. Mr. WHITTEMORE opens with a quotation from Sir PHILIP SIDNEY, and the following sentence of his own prefixed as a motto:

The Scrap-Heap—that inarticulate witness of our blunders, and the sepulcher of our blasted hopes—the best, but most humiliating legacy we are forced to leave to our successors, has always, to me, been brimful of instruction.

The body of the paper continues in substance as follows. The nature of Mr. WHITTEMORE's proposed

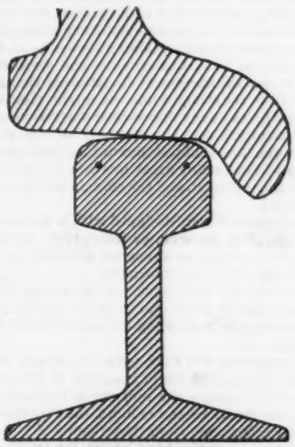


Fig. 1. Present Practice.

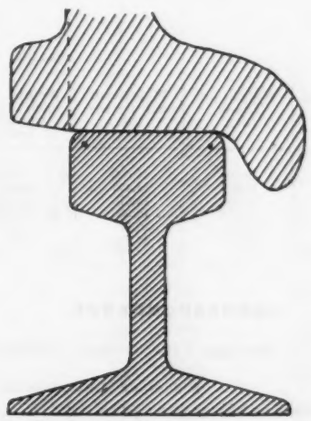


Fig 2. Suggested Practice.

Relation of the Forms of Rails and Wheels.

[Sections ⅛ full size.]

rail and wheel section is shown in the accompanying cut, Fig. 2:

Present practice imposes from two to three times the weight on railway wheels that was customary a few years ago. This taxes not only the permanent way, rolling-stock and engine-power to the utmost, but also the genius, and I may say, the courage, of the engineer in his endeavor to secure safety under the most trying conditions.

Economy of train service has become so important that it is safe to say there will be no return to lighter loads unless it shall be thoroughly demonstrated that both safety and economy require it. Instead of this being the result, I apprehend that still further increased capacity will be demanded, until the loads carried will be limited on our standard gauge only by the size of the cars that can pass over the line with stability and at such velocity as may hereafter be demonstrated as practicable.

Car wheels and rails to the value of nearly a billion dollars pass into the scrap-heap every few years on this Continent alone. It is my belief that they would give a much longer service if they were designed and constructed according to established and well-known laws of mechanics. In this we have been too long the slaves of precedent. In making this broad statement, I do not wish to imply that through nearly 40 years of professional service I have been without guilt in the matter of which this paper treats; or that the persistence in error is confined to American engineers, for the particular errors to which I allude probably exist in a higher degree outside our country.

If it is true that the tendency is to heavier loads, and that the scrap-heap claims wheels and rails which should be capable of longer service—and I think there is no one here who will dispute it—then there is hardly any one problem that deserves the earnest consideration of our members, and of this Society, more than the question of the relation of wheels and rails to each other. The disastrous effects produced by the monstrous loads per wheel must surely impress us with the necessity of an early solution of the problem they create. It would be interesting if we could determine what should be the tonnage service of rails.

The report of your Committee on the relation of wheel and rail to each other indicates that this is approximately 10,000,000 tons to 84-100 lb. per yd. of tangent rail abrasion. If the section of rail referred to approximate the one shown in the report, this seems that the rail should be worn down about one millimetre. COUARD of France estimates that one millimetre of wear corresponds to 16,800,000 tons, and that a rail can be made that can be worn down to ten millimetres. LANINO calculates the life service at 150,000,000: and FUNK of Germany, 125,000,000, and the latter states that a good rail may be worn down over ½-in.

Many of our rails go into the scrap-heap with only 1-16-in. abraded. Undoubtedly this is partly due to poor material in many instances, but in the larger sense, I contend, it is due to faulty design of rail.

It is equally interesting and pertinent to inquire into the wear of wheels reduced to a tonnage basis. Of the ordinary cast-iron car-wheel we have an abundance of statistical information as to its mileage; but I have not at hand the data requisite to permit me to determine the ton service with that approximate degree of accuracy desired. Of engine drivers I gather from an interesting paper read before the Institution of Civil Engineers, a few years ago by W. STROUDLEY, of the London, Brighton & South Coast Railway that tires of locomotive drivers 76 ins in diameter, carrying a weight of 8.4 net tons, wear down ½-in. for each 28,000 miles of travel. This would indicate that the service of this ½-in. was 60,800,000 tons, or for a wear of one millimetre 19,000,000 tons.

Through the kindness of our member, Mr. J. N. BARR, Superintendent of Motive Power or the Chicago, Milwaukee & St. Paul, I am able to present the following table, showing tire wear of 40 locomotives that had made an aggregate of over 6,000,000 miles—equivalent to turning one wheel 27,000,000 miles, and carrying a weight of from 14,000 to 16,000 lbs.—from which we deduce the result that a tonnage of 41,000,000 causes a wear of ½-in. in the tread of the tire.

Reduced to ton service for ½-in. wear of tire, the approximate average is:

Wear of Tire, C., B. & Q. Ry.

Class of Engine.	Size cylinders and drivers	Total weight on four drivers	Miles per 1-16-in. wear	
			3-in. tire.	4-in. tire.
Switch engine no truck	15×22—44	50,150	6,045	3,711
Switch engine no truck	16×22—44	59,238	4,675	3,387
Road engine ldg. truck	16×24—53	44,367	7,168	4,937
Road engine ldg. truck	17×24—57	48,960	8,903	7,119
For 3-in. tire				31,380,000
And for 4 in. tire				20,674,000

It will be seen by the preceding table that the tire of the larger diameter gives the better service, as should be expected.

As you are aware, drivers are turned in sets to suit the greatest wear of the most worn wheel; hence this exhibit does not, even approximately, indicate the loss of metal due to abrasion; but I give the information for what it is worth.

Making any reasonable allowance for this loss of metal by turning, let us see what is the tonnage service of steel-tired 33-in. car-wheels under passenger cars of known weight and load, and where the only unknown element of wear enters to modify our conclusions—viz, wear of brake shoes and from sliding—and again I am indebted to Mr. BARR for this information.

Coach No. 235, Chicago, Milwaukee & St. Paul Railway, weighing 61,500 lbs.; passenger load 4,500 lbs.; total 60,000 lbs.; load per 33-in. wheel, 5,500 lbs., ran 95,110 miles, and suffered an average loss of 0.762-in. in circumference of wheel. Having the wear as measured on circumference the weight in pounds carried by same, and the miles run, the following formula will give closely the tonnage service for each ½-in. tread of 33-in. wheel worn down:

$$\frac{6 \times \text{weight on wheel in lbs.} \times \text{miles run}}{25 \times \text{circumference wear in inches}} =$$

tons service for 1-8 inch direct wear in thickness of tire.

In the case cited, the tonnage service for 1-8 inch wear was:

$$\frac{6 \times 5500 \times 95110}{25 \times .762} = 164,757,428.$$

In further testimony, I offer the following table of average circumference wear of 33-in. Allen steel-tired car-wheels of the passenger equipment of the Chicago, Milwaukee & St. Paul Railway, given by Mr. BARR, from which I deduce, by the formula stated, the tonnage service for wear down of tread for 1-8 in. as shown. The average circumference wear is that of two wheels on the same axle.

[The table shows an average of 149.13 million tons service per ½ in. wear, ranging from 109.4 to 253.2 million tons, but for the most part not fluctuating widely from the average. The wheels were under 18 twelve-wheel and 5 eight-wheel cars, averaging about 60,000 miles run each.]

TABLE 1. *Wear of Driving Wheel Tires, Chicago, Milwaukee & St. Paul Railway.*
(All 62-in. drivers; tons of 2,000 lbs.)

Class Engine.	No. of drivers.	Wt. on drivers, tons.	No. of sets.	No. of runs.	Total wear in 32 d's in.	Total miles run.	Miles per ¼-in. tire wear.	Million tons service per ¼-in. wear.	Million tons service per tire.
Freight.									
17 in. R. I.	4	27.725	5	19	193	995,555	20,693	40.51	449
" "	4	27.725	5	12	173	699,040	16,165	36.44	315
" "	4	27.725	5	17	235	893,320	15,295	34.28	403
Passenger.									
18 in. R. I.	4	29.25	5	19	291	978,506	19,473	46.30	405
" "	4	29.25	5	14	159	744,453	18,728	44.53	354
10-wh'l fr't	6	40.50	10	23	354	1,458,332	17,465	58.35	320
St'd 18-in. pass.	4	32.20	5	5	49	373,319	30,475	72.76	178
Average, excluding the last								41.04	384
Million tons service per millimeter tire wear								12.94	

[The miles run to each ¼-in. wear ranged from 15,205 to 20,633, averaging 17,330 miles for 3 freight engines and 18,560 miles for 3 passenger engines, all with 62-in. drivers. A 68-in. passenger engine gave 30,475 miles and 72,759,000 tons, the highest for 62-in. wheels being 46,512,000 miles. The total miles run was about 1,000,000 miles per engine.]

Through the courtesy of Mr. G. W. RHODES, Supt. of Motive Power of the Chicago, Burlington & Quincy Railway, I give this tire wear of several standard locomotives in use on his line, in which there is shown a great difference in service in the use of tires of different thickness, and in both cases much lower service than is shown by Mr. BARR's report.

From the same source I gather the following data in reference to the performance of 42-in. steel-tired Allen paper wheels with cast-iron hubs, and reducing to tonnage service for direct wear of 1-8 in. the formula is used.

$$\frac{\text{Mileage} \times \text{weight in lbs. on wheel}}{3\text{-}10 \times \text{circumference wear in inches}} = \text{tons service,}$$

Wt. of car and av. load	No. wheels	Wt. per wheel	Miles run	Wear in ins. circ.	Tons per ¼-in. wear
82,000	12	6,833	105,430	0.900	151,061,524
82,000	12	6,833	93,503	0.600	204,027,112
			Average		177,544,318

LOADS PER WHEEL, PENNSYLVANIA RAILROAD.

Passenger Equipment Cars.

KIND OF CAR.	Weight lbs.	Load lbs.	No. of Wheels.	Weight on each wheel. lbs.
Passenger	50,000	7,830	8	6,902
Baggage	34,700	16,000	8	6,411
Express	32,500	14,000	8	5,486
Postal	58,000	20,000	12	6,174
Combination	39,500	16,000	8	6,611
Emigrant	36,500	7,830	8	5,867
Freight Equipment Cars.				
Box Car "Xa"	30,100	60,000	8	10,682
Stock "Kd"	27,800	60,000	8	10,435
Coal "Gd"	23,500	60,000	8	9,797
Tenders.				
Passenger	29,300	35,250	8	7,528
Freight	29,000	40,300	8	8,127

Weight of Freight Car Axle .....400 lbs.; passenger, 326 lbs.
" " " " .....540 " " 540 "

Weight on each wheel is exclusive of weight of wheel.
Weight of Box and Stock Cars includes air brakes and fixtures.

Locomotives.

CLASS.	Diam. of Driving Wheels.	Diam. of Truck Wheels.	Weight on Drivers. lbs.	Weight on Truck. lbs.	Weight on each Driver. lbs.	Weight on each truck wheel. lbs.
A—Passenger	68-in.	33-in.	64,000	29,500	16,000	7 375
N— "	62 "	33 "	54,700	33,600	14,425	8,400
O— "	62 "	33 "	58, 00	33,600	14,575	8,400
P— "	68 "	33 "	67,800	32,800	16,950	8,200
R—Freight	50 "	28 "	100,600	14,025	12,575	7,012
K—Expr. Pass.	78 "	33 "	64,900	31,800	16,225	7,950

NOTE.—Weight on each wheel includes weight of wheel.

Through the kindness of our member, THEODORE N. ELY, General Superintendent of Motive Power of the Pennsylvania Railroad, the above table, showing th weights per wheel carried on that line, is compiled. The freight tariff of that company, however, permits 84,000 lbs. paying load, where 60,000 is stated in this table.

When we make allowance for wear, due to brake-shoes and the flow of metal, the tonnage service for abrasion, due to rail contact will be largely increased. How it is that there is such disparity between engine-drivers and passenger-wheel tonnage service will appear, if my premises are correct, further on.

In fact, there are so many varying and conflicting conditions, and so much data wanting, such as loss by corrosion, etc., that it seems about as impossible to determine a fair expression for abrasion due to rolling load alone, as to have the Missouri river act according to mathematical formula. I submit that the facts presented indicate clearly that failure does not result so much from abrasion as from some other cause.

To secure increased service of wheels and rails, the remedy proposed by the author is indicated by the caption of this paper, viz., "Cylindrical Wheels on Flat-Topped Rails." I do not wish it understood that I mean that the entire width of rail-top should be flat, or that if made so it would continue so for any length of time. The difference in gauge between wheel-flanges and rails permits a lateral movement of, say 5/8 in. or more. Owing to difference of wear by reason of wheels running to or from flange, a curve characteristic of this wear is produced, which will extend along the line of bearing from the flange contact, a distance equal to at least one-half of this lateral movement of wheels on rails, making the origin of the curve about 5/8 in. from the side of the rail-head. This will hold true also for both top corners of the rail. The balance of the rail-top, I contend should be flat.

(TO BE CONTINUED).

THE WEIGHT OF MAIL MATTER sent from New York, Philadelphia, Baltimore, Washington and Richmond for one week in June, 1888, was 55,241 lbs. During January, 1889, the mail matter originating in the New York post office alone amounts to 179,320 lbs. per day, while the matter received from other offices swells the daily aggregate to 205 tons. It is estimated that the Pennsylvania Railroad carries daily about 150,000 lbs. of mail matter between Philadelphia and New York, and about 100,000 between Philadelphia and Pittsburg; while the Baltimore & Ohio carries about 40,000 lbs. daily on its through trains, and the Vanderbilt lines about 100,000 lbs. between New York and Chicago. In 1866 mails were carried over 32,092 miles of railway, and in 1888 the figures had risen to 143,713.

CORRESPONDENCE.

Johnson's Straight-Line Column Formulæ.

SCHOOL OF MINES, Dec. 31, 1888.

TO THE EDITOR OF ENGINEERING NEWS:

Your issue of Dec. 22 contained an article by Mr. THOS. H. JOHNSON on column formulæ, which alludes to his paper published in the Transactions of the American Society of Civil Engineers for 1886. I read the paper with great interest, and am glad of the opportunity to acknowledge the value that the accompanying diagrams have been to me in my work of instruction, in showing the general field of plotted experiments, and illustrating the relations of the various column formulæ proposed. They also show, I think, that Mr. JOHNSON'S straight-line formula, in connection with EULER'S, occupies well the mean of the field of experiments and makes a satisfactory working formula.

So far I wish to pay tribute to Mr. JOHNSON, and acknowledge the correctness of his position; but in his recent article he claims a certain theoretical authority for his formula that I cannot see that it possesses.

Referring to the article in question, it will be remembered that the strung bow is employed as an illustration of a long column, and an admirable illustration it is, but I cannot see that it is correctly made use of in this case. Mr. JOHNSON states that "the conditions of stress in the bow are those due to flexure alone." I think that a section at the middle is subjected to a direct thrust equal to the tension in the strings, and also, at the same time, to stresses of tension and compression due to flexure or bending moment.

This opinion is based upon the well demonstrated mathematical principle, that the effect of a force upon a point outside of its line of direction is two-fold; 1 the direct action of the force upon the point, and 2, the moment of the force around the point.

Mr. JOHNSON argues that the above theory, regarding the conditions of stress in the bow, and therefore in the column, is untenable, because it makes "the load expend its entire energy in producing compression, and *at the same time* develop an equal amount of energy in producing flexure. This would require that the sum of all the parts be greater than the whole."

Now, is this a case in which reasoning based upon the principle of the conservation of energy is applicable? Is any energy expended? The load on the column has a certain potential energy in virtue of its position; but does it not retain it, unless the column breaks? Of course, when a body comes to rest, all the work of resistance must just equal the work expended; but in the case of a column, there is no motion, and therefore no work.

It is a case simply of pressure and its resistance, not of work; and in that case, of course, the numerical sum (not the ultimate combined effect) of the resistances may be greater than the pressure, as shown in many cases. I think this use of the principle of the conservation of energy would lead to the conclusion that the numerical sum of the components of a force must always equal the force itself in amount.

If the force produced motion, then the sum of the *works* of the components would just equal the *work* of the force itself; but that is a different matter.

If I am correct, there is, therefore, no proof against the theory that a column, whatever its length, is subjected to a direct thrust, and also, at the same time, to stresses of tension and compression due to bending moment, and depending in amount upon the deviation of what may be termed its axis of resistance from a straight line.

We have no perfect theoretical column formula. Such a formula should be applicable to all cases, from the prism of short-length ratios to the long column with a length ratio of 400 or more. I believe that it must take account in some form or other of a direct thrust always equal to the load, and of a *tendency* to flexure, which flexure will immediately introduce stresses due to bending moment.

The theoretically perfect column would be perfectly straight, and homogeneous in section; therefore, there would be no flexure, and no stresses of bending moment, whatever its length. The practical column never is such; it is not perfectly homogeneous, and it rarely, if ever, has a perfectly straight axis of resistance, and hence there is a tendency to flexure and resulting stresses; the stress due to direct thrust remaining always equal to the load.

If columns were homogenous, and we knew precisely in each case the amount of deviation of the axis of resistance from the straight line, we might then subject the column to as exact theoretical analysis as the arch but the difficulty is that the elasticity of the material will encourage the slightest flexure to become still more, with a corresponding great increase of the stresses due to bending moment, and the column is at once immensely weakened.

If all columns were designed with a definite amount of deflection, like an arch, or the curved chord of a roof truss, there would be no special difficulty in obtaining a satisfactory theoretical formula.

But under the conditions, the theoretical formula must take account of stress due to direct thrust, and of a *tendency* to flexure, producing stresses of tension and compression.

This tendency will vary with the length ratio of the column, the coefficients of elasticity of the various parts of which it is made, the uniformity in quality of the material, the design of the column, the workmanship, and so many other conditions that I doubt if it is possible to determine any general expression for its law or laws of variation.

This must be done, however, and the result incorporated in the formula for direct thrust, before we can be said to have a perfect column formula.

If I am correct in this position, GORDON'S formula is in the right direction, inasmuch as it takes account of direct thrust and bending moment, but in the factor q lies hidden all the above-mentioned uncertainties that have such an intricate effect upon the tendency to flexure, and therefore upon the strength.

To make it perfect we will have to do far more than assume certain constant values for q, as is now the practice.

EULER'S formula, which ignores the element of direct thrust, is not a perfect formula, and only becomes so for long columns because, while the direct thrust remains constant for the same load, whatever the length, the tendency to deflection and increased bending moment becomes immensely greater as the length ratio increases, and may, in comparison, make the direct thrust of no importance. The degree to which EULER'S formula represents the exact condition of strength must vary in some general direct proportion to the length of the ratio.

The best authority for Mr. JOHNSON'S formula consists in its lying well in the field of plotted experiments, as his diagrams clearly show. Perhaps it is in that respect better than any other formula. It has not, however, if my reasoning is sound, any abstract theoretical correctness.

In fact, from the standpoint of pure theory, it is not to be thought that columns obey the law of the straight line to a certain point, and then suddenly, for longer length ratios, run into EULER'S curve. There must at least be some transition curve from the tangent into EULER'S curve; and I think that transition curve, if we could discover it, would be found to extend from perhaps the extreme of Mr. JOHNSON'S tangent, on the one hand, to the extreme of EULER'S curve, on the other. This is simply another way of saying that the curve of the perfect theoretical formula would probably approximate to EULER'S curve and Mr. JOHNSON'S tangent, but would be a curve throughout.

JAMES L. GREENLEAF.

[It is not clear to us why, even "from the standpoint of pure theory," a column may not "obey the law of the straight line to a certain point and then suddenly run into a curve," and certainly they appear to do so very closely in practice; but we leave our correspondent to state his position.—ED. ENG. NEWS.]

Uniform System of Rivet Signs.

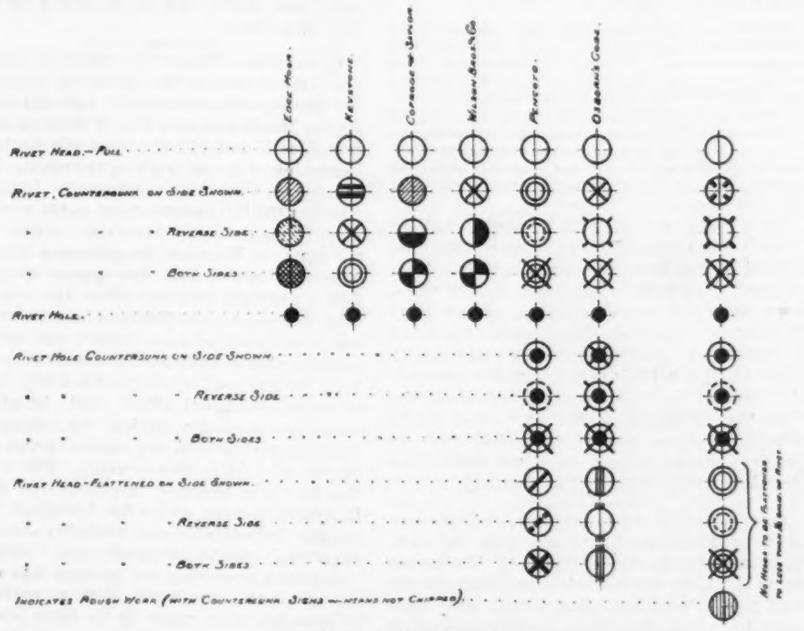
Wilson Brothers & Co., Civil Engs. & Architects,
Drexel Building,
PHILADELPHIA, Pa., Jan. 28, 1889.

TO THE EDITOR OF ENGINEERING NEWS:

The communication in your issue of January 25, advocating the adoption of a uniform system of rivet signs, was read with much interest. The need of such uniformity is best appreciated by those who are thrown in contact with the work of various bridge shops,—either in the inspection of their work, or in making detailed designs which are open to bids from all companies.

While, however, it is evident that such uniformity is desirable, it is equally clear that, in order for the adoption of such signs to be permanent, they should be the best that can be devised, either in convention or through publication. The various parties interested in the adoption of a standard code of signs should give a full expression of opinion; and the signs favored by the majority should be accepted.

About a year ago, the writer, being somewhat dissatisfied with the signs then in use, obtained those of several of



Conventional Signs for Rivets.

the leading bridge companies in order to devise, if possible, an acceptable set. The signs obtained were those of the Edge Moor Iron Co., the Keystone Bridge Co., Cofrode & Saylor, and the Pencoyd Iron Works, as shown on the accompanying print.

Of these signs, those of the Pencoyd Iron Works appeared the most systematic, the most complete, and consequently the best; although, to the writer's mind, not entirely satisfactory. The cross for "both sides" was distinct, and the signs for field rivets were entirely rational, and probably in universal use where notes were not employed.

The requisites of a good system would seem to be that the signs be as rational as possible; quickly and easily made,—preferably free-hand,—and without any unnecessary elaboration. They should avoid vertical or horizontal lines on the center line of the rivet, and while they should be black enough to be distinct, should not require so much ink as to delay drying. The signs of shop rivets, being the most frequently used, are of the first importance.

The writer has usually designated the signs as "countersunk on side shown" and "countersunk on reversed side," or "countersunk above" and countersunk below." Pencoyd and others designated them as "countersunk inside" and countersunk outside."

The natural sign for flattened heads seemed to be the double circle; the inner circle representing the flattened portion on top of the rivet head. The use of a sign for countersunk rivets not chipped would save considerable labor when the character of the work is such as to render chipping unnecessary. Cross lining with the free-hand pen has been added, therefore, as indicating a special condition.

This table is given with a view of presenting the subject in its various aspects. The forms suggested are not an invention, but rather an evolution. They appear to the writer to be the most natural rivet signs.

Very respectfully,

WILSON BROS. & CO.
per HENRY B. SEAMAN.

The Proposed Chicago Sewage Tunnel.

CHICAGO, Jan. 29, 1889.

TO THE EDITOR OF ENGINEERING NEWS:—

My attention has been called to your notice, in ENGINEERING NEWS of the 29th ult., of a recent criticism of Mr. NOTT'S, in the *Chicago Tribune*.

You say Mr. NOTT *** "insists upon his 26-mile tunnel as the best expedient." I certainly do believe that a *lower level tunnel*, with precipitating and settling basins below Joliet for the sewage disposal of Chicago, or a metropolitan district, is the "best expedient," and wish this answer to be a matter of record for you and others, who may be living at the time of completing an open way for the outlet of sewage, to refer to when you see that it has utterly failed to meet the requirements of sewage disposal for this great metropolis, and has only added to the debt without bringing relief.

The tunnel across Dorchester bay for Boston's "main drainage works" was about 11 ft. in diameter before backing or lining, and was through a slaty, bad rock, where only about 4 ft. or 5 ft. progress could be made per 24 hours, and giving, say, 12 cu. yds. or 13 cu. yds. excavation. Such work would cost three or four times, per cubic yard, that through the easily-worked lime of the sewage tunnel, with regular strata and large cross-section. You say the tunnel of two miles under Dorchester bay cost more than my estimate. This cost was about $640,000 instead of more than about $9,600,000.

The Croton tunnel had a diameter, before backing and lining, of 18 to 20 ft., and was bored through rock which would bear no comparison with the cost for moving lime rock of thick and regular strata. The cost of this tunnel, with its requirements, lead me to think that my estimates are reasonably right.

The Arlberg tunnel, about 6½ miles long, cost about $5.00 per cu. yd. worked from 2 faces only, and therefore cannot be compared with the sewage tunnel with 30 or more shafts about 3,000 ft. apart, and an average depth to the bottom of the tunnel about 80 ft.

I have the opinion of some of the ablest engineers of the country as to my estimates, and only one of them exceeds my estimates. His estimate only exceeds mine by about $500,000. The engineer making the largest estimate based his figures on a rock of more uncertain character than lime rock, which is quarried in immense quantities near line of tunnel for a market. All agree that my quantities are ample.

I have taken your advice to revise my estimates, and still believe, assuming the present condition of labor and the cost of material of to-day, the actual work would find them reasonably right.

Yours truly,

GORDON H. NOTT.

[While Mr. NOTT has doubtless studied the problem more closely than we have, we must still doubt the figure of $65 per linear foot as safe for a tunnel 20 ft. in diameter, notwithstanding the estimates of "some of the ablest engineers." The Croton tunnel had at least two working faces for each mile of tunnel, and the rock was not so bad as Mr. NOTT would imply. The Arlberg tunnel cost $750 per metre, or about $228 per linear foot. As our correspondent says, it had only two faces in 6½ miles and will not bear comparison; but as we said before, the discount on this price is heavy. As showing that too much faith should not be put in the good working qualities of limestone rock, we might cite the Laurel Hill tunnel, on the South Pennsylvania Railway. This material is officially described as "hard limestone, level bed;" and yet it cost $11.03 per cu. yd. to remove, while "hard gray slate" in the Negro Mountain tunnel on the same line cost $4.10 per cu. yd. Mr. NOTT misunderstands us in the reference to the Dorchester Bay tunnel. What we intended to say was that it cost more *per linear foot* than his estimate. It is possible that the ruling conditions are so very favorable on this 26 miles of work as to warrant Mr. NOTT and his engineering friends in their figures; but if it at all follows the usual rule of long rock tunnels in ultimate cost, the contractor will be most happy who most generously provides for "contingencies."—ED. ENG. NEWS.]

Notes, Queries and Answers.

S. EDWARD BATES of Richmond, Va., wants the address of parties manufacturing portable cottage buildings.

The Ducker Portable House Co., of 32 Nassau St., New York, manufactures a portable house built in sections, made of wood and covered with an indurated fibre. It is recommended as particularly well adapted for mining camps, survey and prospecting parties, etc.

JOHN T. PRICE, C. E., of Kansas City, Mo., asks for the whereabouts of a description of the McCallum patent timber bridge. In Appleton's *Mechanics' Magazine and Engineers' Journal*, of April 1, 1852, will be found an illustrated description of a bridge of 200 ft. span of this type erected over the Susquehanna river at Lanesboro, on the line of the then N. Y. & Erie R. R. The patent of Mr. D. C. MCCALLUM was for a timber bridge with an arched top chord, in which the arch action was made an integral part of the truss itself, as contrasted with the arched Howe truss in which these members acted independently. We do not know of any such bridges in our correspondent's vicinity; but if he can not readily refer to the *Mechanics' Magazine*, he can obtain from the U.S. Patent Office a copy of the original patent and its specifications.

J. C. McV.—The Baldwin Locomotive Works receive apprentices, and a practical knowledge of mechanics, especially of the locomotive, is an immense help to an engineer, or an excellent foundation for more strictly technical knowledge, if gained without too great a sacrifice. You should apply to them direct. The pay is 50 to 70 cts. per day in first year, increasing to $1.00 to $1.40 per day in fourth year. It is generally considered, however, that there is a better chance for young men to learn in smaller shops; and as a rule (with many exceptions), spending such an amount of time in shops deprives a man of all chance to become an engineer in the professional sense, although opening other good chances in life to him. All depends upon the man. The right man, whose heart is in his work, may make such an apprenticeship the stepping stone to a very successful career.

THE *Journal of the Society of Arts* reports the discovery of a new textile on the shores of the Caspian. This plant, called "kanaff" by the natives, grows in the summer, and attains a height of ten feet, with a diameter varying from two to three centimetres. By careful cultivation and technical manipulation, M. O. BLAKENBOURG, a chemist and engineer, who has made a special study of kanaff has obtained an admirable textile matter. It is soft, elastic, and silky, gives a thread which is very tough, and can be chemically bleached without losing its value. The stuffs manufactured out of kanaff, and then bleached, can be successfully dyed in every shade of color, and would compete with any of the ordinary furnishing materials now in use; but it is particularly for making sacks, tarpaulin, ropes, etc., that this new textile, from its cheapness and its extraordinary resisting power, might defy all competition. Its specific weight is much less, but its resistance much greater, than those of hemp. Thus, a cord of 8.25 millimetres diameter, woven with the hand out of three threads of kanaff, requires a weight of 180 kilograms to break it. A cord half an inch thick, manufactured at Moscow, did not break till the weight of 625 kilograms was reached. When it is considered that Russia annually consumes more than 150,000,000 of sacks, a third of which are imported, it may be easily seen that the appearance of this new textile on the Russian market is an event of no slight importance

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Drawings for publication *should preferably be in plain black and white, considerably larger than they are expected to appear, with letters and figures in pencil only, all lines clean and bold.*

Coming Technical Meetings.

Civil Engineers' Club of Cleveland, O.—Regular meeting, Feb. 12. Report on Applied Science. Secy., James Ritchie, Case Library Rooms.

New England Railway Club, Boston, Mass.—Regular meeting, Feb. 13. "Steam Couplings for Pa senger Cars." Boston & Albany passenger station.

Engineers' Club, Philadelphia, Pa.—Regular meeting, Feb. 16. Secy. Howard Murphy, 1122 Girard St.

Engineers' Club of Kansas City, Mo.—Regular meeting, Feb. 18 Secy., Kenneth Allen, Y.M. C. A. Building.

Engineers' Society of Western Pennsylvania, Pittsburg, Pa.—Regular meeting, Feb. 19. "Thomson Electric Welding Process", H. D. Hibbard Secy., S. M. Wickersham, Penn Bldg.

American Institute of Mining Engineers.—The 53d meeting will be held at New York, on Feb. 19. Secy., R. W. Raymond, 13 Burling Slip, New York.

American Society of Civil Engineers, New York.—Regular meeting, Feb. 20. Secy., John Bogart, 127 E. 23d St.

Engineers' Club of St. Louis, Mo.—Regular meeting, Feb. 20. "Elevated Railways", Geo. H. Pegram; "Tests of, and Specifications for, Cast-Iron", Prof. J. B. Johnson. Secy., Wm. H. Bryan, 709 Market St.

Boston Society of Civil Engineers, Boston, Mass.—Regular meeting, Feb. 20. Secy., S. E. Tinkham, City Hall.

New York Railway Club.—Next meeting Feb. 21. Rooms, 113 Liberty St., New York City.

Western Society of Engineers, Chicago, Ill.—Regular meeting, Mar. 6. Secy., John W. Weston, Gaff Building.

THE furious controversy as to "English vs. American locomotives" still rages in the English engineering papers. In the last issue of *The Engineer* there are three columns about it, under the slightly varied head of "The New South Wales Locomotive Question." In the meantime, calmness reigns on this continent. The Pennsylvania Railroad has imported one English compound locomotive to experiment with, as we noted last week; but it would be impossible to excite a living interest in the main controversy here, although this is generally a country very friendly to new ideas. We notice, however, that the pictures of new English locomotives begin to look more and more like American ones. Equalizers, leading truck, outside cylinders, horizontal cylinders, a gradually enlarging cab;—all are there, with very slight and superficial remaining differences, the most important being the plate instead of the bar frame. The natural inference is that there is some reason for this long drawn out controversy in a general feeling against the long familar English type.

The Australian controversy is a very funny side issue. Some one, it appears, has been audaciously reporting to the Australian Minister of Public Works that certain locomotives "are evidently poor copies of the American Consolidated engines, and have ignominiously failed," when, as a matter of fact, these engines, "while retaining the substantial character of the English engine (to keep it from dropping all to pieces, we suppose) possessed in the fullest degree the flexibility claimed for the engines used in Canada and the United States." After a few words for the attacked engines, the correspondent, who effectually conceals his identity under the *nom de plume* "Justicia," proceeds to remark, about the Simon-pure American Consolidations which have been unloaded on Australia through machinations of the Baldwin Locomotive Works:

"But there is a still more important objection to the Consolidation, which is the much greater wheel base that causes the leading bogie wheels to lift off the rails when running round the 8-chain curves on the Western line. When this was pointed out to the Baldwin Company, who built and introduced them into the Colony—through the instrumentality, be it remembered, of the present Minister of Works, who was then also in office for a short time—they admitted it was a defect, and upon their suggestion several schemes have been devised to effect a cure, all of which have failed."

An 8-chain curve is of 528 ft. radius, or about 10° 50′. The Consolidation engine was first designed to run over 12° curves, and has been running over them, and many sharper ones, ever since 1872, with conspicuous success and without the slightest objectionable tendency to derailment as compared with other heavy engines. Yet all this seems to go for nothing. A perennial crop of vague and loose assertions, like the foregoing, seems to spring up in English journals and reports, and finds as ready belief as if there were not nearly two decades of experience to the contrary.

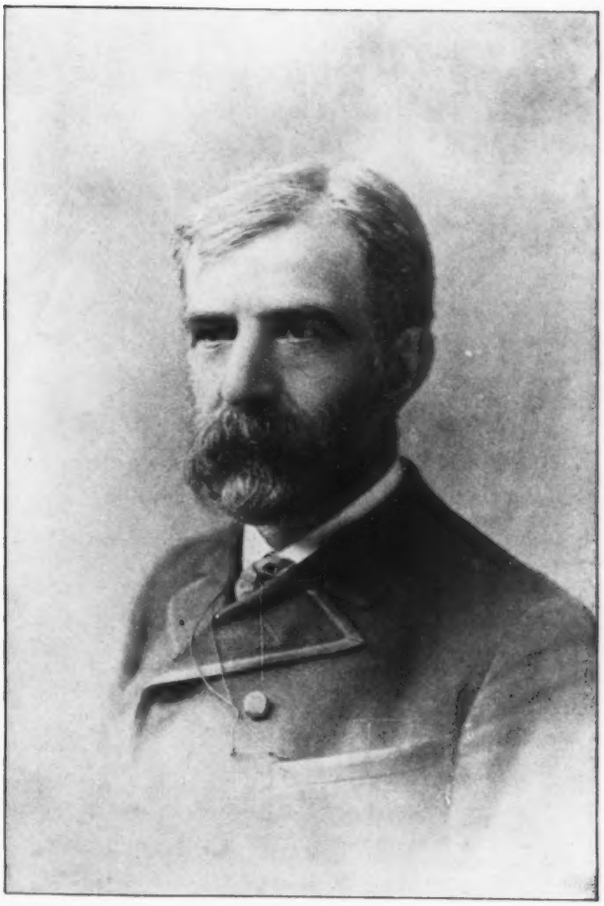
OUR esteemed contemporary, the *Railway Age*, should add another engineer to its staff, or pass questions out of its line. We notice in its last issue the following response to the query of a searcher after truth, who asks them to "please inform a subscriber how much per degree in 100 ft. will the inside rail gain on the outside rail in curves:"

"The difference between length of inner and outer rails on curves is practically insignificant. On a 20° curve, radius 287.9 ft., the inner rail will be about .0125-in. shorter than the outer. On an 8°-curve, radius 716 ft., the difference will be about .005-in. In laying track, no effort is made to keep the ends of outer and inner rails exactly opposite each other, but rails cut about 6 ins. shorter than the regular length are occasionally laid on the inner side of curves if found necessary."

It would be difficult to get farther out in a single paragraph, correcting which affords us the opportunity to say what even engineers do not always remember—that the difference in the length of inner and outer rail can be determined at once, without using in the computation the actual radius, or distance from the length of an arc *of radius equal to the gauge*, of a central angle equal to the given curve. The gauge, however, must be measured from center to center of rail for this purpose, and not from the inside edge, for obvious reasons, and is ordinarily 4 ft. 11 ins. The circumference of a complete circle of that radius, as may be determined from any table, is 30.89+ ft., which is consequently the difference in length of inner and outer rails of a complete circle of 360° for any radius whatever. An arc 20° long, whether it be 1 station of a 20° curve or 20 stations of a 1° curve, will cause a difference of length of 1-18 of this amount, or about 1.72 ft. instead of .0125 in. In a 30-ft. rail, which covers a central arc of 6° on a 20° curve, the difference will be 30.892 ÷ 60, or 0.515 ft. In a station of 8° curve, the difference will be 1 45 of 30,892 ft, or 0.686 ft. (8¼ ins.) instead of .005 in. In a 30-ft. rail length, this will amount to nearly 2.5 ins. In laying track a great effort is made to keep the inner and outer joints within an inch or two of being exactly opposite, if the joints are opposite at all, which in our judgment they never should be, on curves at least. But the usual rule is, if all joints are to be opposite, to have some of the rails cut 2 ins. and not 6 ins. shorter, for use on curves. It is still more common, and much better, to lay the curve at least with broken joints, when precise equality of spacing becomes unimportant; and it is getting to be still more common, and in our judgment better yet, to lay all joints broken both on curves and tangents, when the difficulty vanishes, since a curve even 90° long makes a difference of only 7.7 ft. in length of outer rail, which can be recovered by using four 28-ft. rails.

IT would be difficult to exaggerate the possible importance of the successful passage of the bill incorporating under national authority the Maritime Canal Co. of Nicaragua, followed, as it undoubtedly soon will be, by the beginning of actual work on the canal. Technically, it was not particularly important whether the bill passed or not, as the company already had a very favorable charter from the State of Vermont, in substance identical with that which has now passed Congress. But a national charter gives the company what it needs to raise funds on favorable terms, and is well entitled to, a certain national recognition and assurance of protection; and we fully believe that the company, if they choose to make sufficient effort, will be able to raise the necessary capital for construction which is not likely in any case to exceed $100,000,000, all told, in this country. The opposition has been inspired largely by the Pacific Railway interests, with a few friends of Panama and Tehuantepec and probably some constitutional cranks, soreheads, and "strikers." The debate preceding the passage was as significant as the vote itself. Several enthusiastic speeches were made in its favor, and Mr. CHIPMAN (Dem.) of Michigan struck what may prove a prophetic note in the hope that "this step is only the prelude to the day when the nation will follow, and we as a people will plant our feet on those regions, and when our flag shall wave over the State of Nicaragua as a State of the United States of America." Nicaragua is a small country of only some 250,000 population, of which perhaps 50,000 are whites; and as there is quite certain to be a large influx of Americans following the construction of the canal, and as Nicaragua will find the maintenance of national autonomy difficult and embarrassing without American protection, it may well be that a sentiment in favor of such a result will grow up in that country, which would be certain to be met if it existed. No "pressure" to bring about such annexation, however, is ever likely to be exerted, and it is in any case a good many years in the future.

WE begin this week the publication of a very full abstract (including all the important parts verbatim) of the interesting and important paper on the form of rails and wheels, read by Mr. DON J. WHITTEMORE at the late Annual Meeting of the American Society of Civil Engineers. Without such a practically complete abstract, justice cannot be done to the new and valuable facts which he has collected, and to the ingenious argument which he bases upon it. As we cannot find space for the whole of it in one issue, we postpone for the present all discussion of the paper,



Very Truly
Yours
Wm J Becker

further than to say that, while we cannot agree with all the details of the argument, and think far too much importance is attached to the probable effect of making the top of the rail dead flat instead of with the usual slight curve, yet we see no objection to that form, and can see that certain considerable advantages might possibly result therefrom. On the main question (as we cannot but regard it) of whether the corner of the rail should be rounded off "to fit the flange," or should be designed with a radius as dissimilar as possible from the fillet radius of the wheel, so as to avoid such a result as far and as long as possible, Mr. WHITTEMORE is entirely in accord with the preliminary conclusions of the Committee on the Form of Rails and Wheels, as expressed in their late report (ENG. NEWS, Nov. 3, 1888, *et seq.*). Whether the top of the rail should be more or less flattened is not discussed except incidentally in that report, where, to be sure, the implied conclusion was rather the contrary of that now expressed by Mr. WHITTEMORE, and backed up by an array of facts which are to a large extent new and well worth studying. One dissent, however, we must express: Near the close of our first installment in this issue Mr. WHITTEMORE submits that the facts presented "indicate pretty clearly that failure does not result so much from abrasion as from some other cause." This is literally true, because poor rails largely mash, but good rails do not, and if by "fail" is meant "wear," we see nothing in the facts to indicate that *wear* comes appreciably from crushing or any other cause but abrasion; and if the claim is that all rails, both good and bad, tend to fail by crushing rather than abrasion, we must dissent.

The South Pennsylvania Railroad.

The long delayed South Pennsylvania Railroad enterprise has at last fallen into hands where, whether completed or let alone, it is no longer likely to become the starting point for another trunk-line war like that which the West Shore caused in 1885. It is officially stated that the VANDERBILTS have purchased the interest of other subscribers to the company's stock, and now hold, not only the controlling interest, but nearly all the stock of the company. The price paid was 60, and the original subscribers thus lose 40 cts. on the dollar and the interest on their investment. While Messrs. B. J. JONES, D. H. HOSTETTER, and others are quoted as still unwilling to dispose of their stock at these terms, they are likely to gain little by holding it, with the control in the hands of the VANDERBILTS, and will probably follow the example of the other holders in accepting the offer.

There can be hardly a question that the purpose of the VANDERBILTS in gaining control of the South Pennsylvania is to remove the ever present possibility of its completion and control by parties who would operate it as a competitor to the Pennsylvania. If it were expedient, the best possible use to make of it would be to complete it and operate it as a part of the Pennsylvania system. The capital already sunk in the enterprise would not be then a total loss, as now; and while there is no doubt that the object of the projectors of the line was to compete with the Pennsylvania for through traffic, and that local development was a minor consideration, the line, if completed, would certainly secure a considerable local traffic and would develop mineral, timber, and agricultural districts of considerable extent.

Unfortunately for the residents and land owners in the southern tier of Pennsylvania counties through which the road was to run, the VANDERBILTS cannot turn the road over to the Pennsylvania control without coming into conflict with the State laws of Pennsylvania, which are backed by a public opinion very jealous of the Pennsylvania Railroad corporation and anxious to place every obstacle in the way of an increase of its power. The road might, indeed, be completed by a subsidiary corporation, or by the VANDERBILTS themselves, and operated in harmony with the Pennsylvania; but it would be difficult to devise any plan of effecting this which would not make the road a constant menace to the peace of the trunk-line family, and a temptingly sharp weapon for the VANDERBILTS to hold in case of any serious disagreement with their chief competitor; so the Pennsylvania managers are not likely to assent to this plan.

One other possibility, the completion of the South Penn. by the VANDERBILTS, for the purpose of openly competing with the Pennsylvania, seems the most improbable of all, while present conditions continue. Both the Pennsylvania and the Vanderbilt managers fully recognize the urgent necessity of peace and the folly of knifing competitors by the construction of parallel lines; and until the present relations between the companies materially alter, there is no prospect of the South Pennsylvania being completed and used as was the West Shore.

There are few railway enterprises in this country of the importance of the South Pennsylvania which have so long halted between incorporation and completion. The original company which proposed to build a railway over this route was the Duncannon, Landisburg & Broad Top Mountain, which was chartered in 1854. Under various names and with many changes in its charter, it maintained an existence as an incorporated company for 30 years. By the new constitution of Pennsylvania, adopted in 1874, which put an end to the indiscriminate granting of charters to new railway lines, the charters already granted acquired a value which induced their holders to keep up their organization until the time when the privileges they had received should be worth paying for. The South Pennsylvania charter was one of these; and its owners held annual meetings at Harrisburg and made surveys from time to time, waiting until the time should be ripe to interest capitalists in the proposed road. In the latter part of 1882, Mr. W. H. VANDERBILT had his attention drawn to the South Pennsylvania project, then put forward as the shortest and most favorable existing location for a railway between the Ohio river and the Atlantic coast. Aside from its promise as an investment, the new road was evidently destined to be a formidable competitor to the Pennsylvania. The West Shore and the Nickel Plate enterprises were both being rushed to completion to fight the Vanderbilt lines; and the Pennsylvania managers were believed to be in sympathy with the movement to cut into the traffic of their powerful competitor. Mr. VANDERBILT concluded that paralleling was a game that two could play at, and through Mr. H. McK. TWOMBLEY, he secured a large interest in the new enterprise. Other heavy capitalists followed his example, for the construction of parallel railways was far more popular among financiers in 1882 than it is in 1889. Stock was taken in large amounts, and the contract for building was let to the American Construction Company, which at once began work upon the several long tunnels which were the prominent engineering feature of the line.

Had it not been for these tunnels, which prevented the line from being finished with any reasonable expenditure inside of two years, there is little doubt that the road would have been pushed through post-haste, and would have been a most effective weapon for the Pennsylvania's competitors in the trunk-line war of 1884 and '85. But at the conclusion of peace in the latter year, the South Pennsylvania was still far from completion; and one of the conditions of the compact then made was that it should be turned over to the Pennsylvania. Some of the stockholders who had been most active in pushing the enterprise, however, were determined that the road should be completed as a competing line from Pittsburg east, and succeeded in preventing the formal transfer to the Pennsylvania by judicial proceedings.

Work on the road was abandoned in the fall of 1885, after about 37,000 ft. of the tunnels had been driven and but 15,000 ft. remained to be done. It was then generally supposed that the stoppage was only temporary and that the road would be completed as part of the Pennsylvania system. This would doubtless have been the case if the before mentioned legal obstructions had not been interposed; and it will probably be the final outcome of the enterprise now. When this desirable occurrence shall take place depends much less on the present owners of the road than upon the lawmakers of the State of Pennsylvania. So long as it is insisted that the line shall not be built except as a new competitor for trunk-line traffic, the experience of 1885 is not likely to be forgotten, and the possibility is now very remote that the South Pennsylvania will ever be the exciting cause of a trunk-line war.

The Water-Works of the Southern States.

We continue our review of the status of water-works in the United States, as developed in the records gathered for our forthcoming "Manual of American Water-Works," with the statistics of the water-works of the South Atlantic and South Central groups of States, including all the States south of the Ohio and Potomac and east of the Mississippi, and also Louisiana, which is divided by the Mississippi. For certain purposes, it might have been better to have included also the Southwestern group, but on the whole it appeared preferable to give the Southwestern and Northwestern groups together, which we shall do later.*

If, as may fairly be claimed, the abundance of water-works in a community is one of the surest tests of its progress toward a high civilization, the status of water-works in the Southern States makes a most gratifying addition to the many proofs of the rapid progress of that section toward equality with all other sections in material prosperity. Superficially considered, the records might seem to indicate that that section is far behind, as it still is in density of population and number of large towns; but in comparison to the number of towns of sufficient size to make water-works possible (the only fair basis of comparison), most of the Southern States are now fully abreast with others, while the rate of progress seems faster, if anything, than in any of the older States.

The astonishing rate at which water-works have been multiplying in recent years, even in the North Atlantic States, becomes still more conspicuous and astonishing in the South, the figures standing as shown at top of next column, and more fully in Tables 1 and 2.

The last two lines of these tables show that, to an extraordinary extent, the water-works interest of all these sections may be said to have been created as a great interest within the last 10 or 15 years; but it is still more true of the South, and of the last 7½ years. In the

*Our previous reviews of the New England and Middle States water-works were published Oct. 13-20 and Dec. 15-22, 1888, if any desire to refer to them for comparison.

No. of water-works opened.	So. Atl.	So. Cen.	To'l So.	To'l N.E.	Mid-dle.
Before 1850	8	8	16	12	30
Decade ending 1860	4	1	5	16	31
" " 1870	6	4	4	32	33
" " 1880	15	8	21	76	118
7½ years " 1888	48	34	82	150	216
A total of	73	55	128	286	433
Per cent in last 7½ yrs.	65.6	61.9	64.0	52.4	50.2
" " 17½ "	83.6	75.3	80.3	79.0	77.4

decade ending 1880, the South was rather behind the North even in per cent. of new water-works, making its per cent. for 17½ years about the same; in all the groups we may say in a general way 80 per cent. of the water-works have been built since 1870.

But to appreciate the full contrast in the rate of Southern progress, it is necessary to consider the aggregate of the works chronicled in our "Manual" as "projected with fair prospects of early construction." Most of these works are now in actual process of construction in all the sections; and while some of them have been dropped, others not so listed have been since started, so that the record fairly indicates the number which are likely to be opened in or soon after the current year; as follows:

Water-Works Projected with Fair Prospects of Construction.

Virginia	7	Alabama	5
West Virginia	1	Mississippi	2
North Carolina	4	Louisiana	—
South Carolina	3	Tennessee	5
Georgia	7	Kentucky	5
Florida	1		
		Total So. Central	17
Total South Atlantic	23		
		Grand total, Southern	40
		Total New England	25
		" Middle	19

This shows a probable increase of 31.5 percent. in the South Atlantic States, and 30.9 per cent. in the South Central, or 31.2 per cent. in the two groups together, against only 9 per cent. in New England and 5 per cent. in the Middle States. The decades preceding and following the war show almost no progress in any of the Southern States, as was to be expected; but this slow rate only makes more conspicuous that since 1880. That the present status of water-works is in fact anything but backward, is evidenced in another way by the fact that in Wales, Scotland, and Ireland, with a population of nearly 10½ millions there are only some 87 water-works, as will appear from statistics to be given later, whereas the South, with a population of under 13 millions and a white population of not over 9 millions, has 128 works already, with 40 more under way. In England proper, with a population of nearly 25 millions and 44 per cent. of it in towns of over 20,000 people, there would appear to be, all told, only 407 water-works, or not so many as in the 5 Middle States, with less than 12 million population, and with a considerably smaller ratio of town population. The South is, therefore, already more than abreast with England and far ahead of the rest of Great Britain. Poor Ireland, for example, with 5,160,000 population, has the liberal supply of *four* water works, so far as all available records indicate,—a fact which speaks louder than words can do of the wretched condition of that unhappy island. There were not wanting predictions that when "the late unpleasantness" came to an end, the South was to become "an American Ireland." It needs no statistics to prove now that this has not been the case; how far it is from being so those records show.

Tables 3, 4, and 5, showing by States the main statistics of water-works, call for no special remark except to notice that the South Central States, while having the smaller number of water-works (55 against 73) have nearly twice as large a capital, 45 per cent. more revenue, and a considerably larger mileage of mains and number of taps. The more interesting records are those contained in Tables 6, 7, and 8, showing deductions from the main statistics.

The unfairness of using total population as a basis for comparing water-works statistics is strikingly brought out in Table 6. While the total population of the two groups of Southern States is nearly 13 million as against nearly 12 in the Middle States, the total *town* population (in towns or cities of 4,000 or over) is barely one-fifth as great, the per cent. of such town population being only 8.9 per cent. in the South against 47.2 per cent. in the Middle States. It will be seen by the next to last column of table 6 that the total population on water-works is 107.1 per cent. of the total *town* population in the Southern States against 113.1 per cent. in the Middle States and 120.6 per cent. in New England; a closely approximate ratio from any point of view; but when we consider the large colored population of the South, which pays hardly any taxes, and is not so progressive an element as our own laboring class, and when we consider further how short a time it still is since the war, and that the sources of supply are inferior, as we shall see, the showing is from every point of view a remarkably good one. Again, we find from our lists that there are in the whole South only 6 towns which had a population of 4,000 or over in 1880 which have not now water works, at 2 of which water-works are projected; or no more in proportion than in the New England and Middle States. In 6 States out of the 11 there are no such towns without water-works. The list is as follows:

Towns without water-works	*Population.*	
New Berne, N. C.	6,443	
Greenville, S.C.	6,160	(projected, but now indefinite)
Key West, Fla.	9,890	
Jackson, Miss.	5,204	
Natchez, Miss.	7,058	(projected)
Hopkinsville, Ky.	4,229	

Table 7 shows likewise very creditable progress in the South. The percentage of the total number of water-works in towns of various sizes is:

	Southern.	Middle.	N. Eng.
Towns of 1,000 or under.	17.2	10.9	13.9
" " 3,000 " "	49.1	51.0	41.8
" " 5,000 " "	60.6	69.0	64.3
" "10,000 " "	78.6	87.0	81.2

The percentage of small towns supplied is greater in the South than in either of the other sections.

The statistics of Table 8 are of special interest as indicating the comparative status of water-works. The investment per head on water-works will be seen to be $18.25 in the South Atlantic group and $26.50 in the South Central ($22.80, average of entire South) as against $25.40 in the Middle States and $35.30 in New England; certainly a most creditable showing, in connection with the fact that there is as large a proportion of the town population supplied with water-works in the South as elsewhere. The cost per mile of main ($17,180) is higher than in New England but lower than in the Middle States, largely owing to the presence of a few very costly water-works in the latter. The cost per tap is higher in the South than in either section.

The revenue per head ($2.04) is lower, and the revenue per tap ($25.30) higher than elsewhere, indicating clearly that there is a smaller proportion of the population potentially supplied which uses the water, as is but natural. The revenue per mile of main ($1,533) is but little larger than in New England, and far below the Middle States, indicating that there is no waiting for great inducements before building works. The population per tap (12.4) is very large, owing to the cause just noted, that many who might do not use the water. The population per meter is also large, 224 against 181 in the Middle States and 63 in New England.

The per cent. of revenue to cost is 8.93 against 9.40 per cent. in the Middle States and 7.54 in New England. In the South Central group, however, which seems to the most progressive, it is only 8.13, and in Kentucky and Tennessee under 7 per cent.

The greater difficulty of obtaining good sources of supply is indicated in Table 9, which shows by the small percentage of gravity works that the facilities for good water supply are inferior. In 5 of the 11 States there are no gravity works, and in 3 others only one each, the two most northerly States, with a little corner of North Carolina, containing practically all the gravity works, which are only 17, or 13.1 per cent. against 42.4 per cent. in the Middle States and 50.4 per cent. in New England. The contrast is owing to natural causes, which are well understood, and which we need not go into. The further north we go on this continent, the more lakes there are; and in the South, which is wholly of a sedimentary formation, and has never been subjected to ice action, lakes are rarely or never met with.

It will be seen that tanks and stand-pipes are chiefly used for pumping works in the South, and reservoirs comparatively little. We reserve further discussion of this point, however, until we review the United States as a whole.

The table of sources of supply (Table 10) shows another striking contrast between the Southern and Northern water-works. "Surface," "brook," and "lake" supply are almost wholly eschewed in the South, for a very good reason. Wells are far more used than in the North Atlantic States, and rivers supply a much larger proportion here than elsewhere. Springs also are largely relied on, but chiefly by pumping from them.

Tables 11 and 12 show the pressures used, which average 62 to 66 lbs., or 5 to 10 lbs. lower than in the North Atlantic States. About half the works reporting use higher fire pressures, the favorite fire pressure being 90 to 100 lbs., and the common increase above working pressures 30 to 70 lbs. There are several works, however, with very high pressures of nearly 200 lbs.

The ownership of the works, as shown in Table 13, is another interesting point. In this also the South compares extremely well with other sections, if the percentage of works built by the public be taken as a criterion. The comparison stands as follows:

	So. Atl.	So. Cent.	Total So.	Mid-dle.	N. Eng.
Per cent. of public works, by no.	56.3	23.6	42.2	33.5	41.4
" pop'n supl'd on pub. wks.	64.4	21.5	39.5	78.3	72.3
Population per private works	6,000	13,080	9,840	4,920	3,980

The unfavorable contrast in the last two lines is due almost wholly to the single city of New Orleans (216,090, population) which happens to be supplied by private water-works (the largest city in the United States, by far, so supplied). Louisville also (123,758, population) has been classed as supplied by private works, perhaps improperly, as the city has from the first owned a majority of the stock. Such public control of a private company, seems to offer a very sensible way for cities to take hold of water-works, as it gives most of the advantages of city and private ownership combined. These two cities include 51.2 per cent. of the water-works population of the Central group, and 30 per cent. of both groups together. Had they been included with the public works (and New Orleans also has aided its water-works), the total population supplied by public works would have been 70 per cent. in the South or substantially the same as in the North Atlantic group. Virginia, West Virginia and Georgia stand very high in this respect, and most of the South Central group rather low, as will be found to be the case in the West generally.

Meters are not much used in the South, yet Table 14 shows that the banner town of the

whole country in this respect is there,—Atlanta, Ga., with 2,000 taps, all metered. Montgomery, Ala., and Lexington, Ky., have also a large number, but there are only 8 works in the whole South with so many as one-sixth of their taps metered, and there are only 5,453 meters in the South in all, against 34,046 in the Middle States and 37,813 in New England. Our Atlanta report specifies that the meters have "proved a great saving to the city, reducing the pumpage and increasing the pressure. Unfortunately the consumers choose their own meter, often putting in a size smaller than the service-pipe, thus running the meter to death."

Hydrant rentals, as shown in Table 15, run high in the South. The average is fully $50, against perhaps $30 in New England and $40 in the Middle States. The higher price has no doubt come about as an inducement for the construction of works, the absolute money value of a hydrant per year being as essentially indeterminate as the proper rates of freight on wheat.

Table 16 shows the ever-interesting facts (to a few at least) of the comparative use of pumps. In preparing this table we have not taken the trouble, as we have done in previous tables, to show the aggregates for each State separately, since the number of works per State is so small. It will be seen that the Worthington pumps have a much less decided lead in the South Atlantic than in the North Atlantic States, and that in the South Central group the Holly-Gaskill pumps have a decided lead over all others; but these two makes together include much more than half the total pumping capacity, excluding the always large class of miscellaneous, which includes water power, local or special designs of pumps, and a few small makers. The Blake, Davidson, Deane, and Knowles pumps are also largely used in the South. The total pumping capacity rises to the large aggregate of 366,100,000 galls., against 342,100,000 galls. in New England, and 981,200,000 galls. in the Middle States.

The dams,, tunnels and reservoirs in the Southern States are on so small a scale that it hardly seems worth while to describe them in detail. There is no dam and there are few reservoirs of any considerable size. The most interesting reservoir is that at Knoxville, Tenn., whose sudden catastrophe was described in our Vol. XI, pp. 92, 93. There is a tunnel of 200 ft. at Memphis, another of 684 ft. at Covington, Ky., and two others of 400 and 2,300 ft. under way at Birmingham, Ala., which seems on the road to become a great city. As a whole, the water-works of the South are highly creditable to it.

TABLE 15-C.D.

SOUTH ATLANTIC AND SOUTH CENTRAL STATES WATER-WORKS.—HYDRANT RENTAL.

(Nearest even $5 taken.)

Hydrant rate.	South Atlantic	South Central	Total South'n	Total Middle	Total N. E.
Free	1	.....	1	11	14
$ 5	.....	.....	.....	8	1
10	.....	.....	.....	10	6
15	.....	1	1	16	11
20	.....	.....	.....	10	11
25	2	1	3	13	7
30	1	.....	1	10	17
35	2	1	3	9	8
40	4	3	7	17	13
45	1	1	2	8	4
50	5	9	14	20	16
55	1	1	2	1	.....
60	2	7	9	5	1
75	2	2	4	1	1
90	.....	.....	.....	1	.....
100	.....	.....	.....	1	.....
Total	26	28	47	141	110

The above includes all the works which report a hydrant rental separately. Nearly all the private works receive an indirect rental of some stated sum including water supply of city buildings, etc.

TABLE 1-C-D.

SOUTH ATLANTIC AND SOUTH CENTRAL STATES WATER-WORKS.—SUMMARY OF DATES OF CONSTRUCTION.

[Date of completion taken when construction extended over more than one year.]

YEAR.	Water-Works Built.			YEAR.	Water-Works Built.		
	So. Atl.	So. Cent.	Total.		So. Atl.	So. Cent.	Total.
Before 1800	1	.....	1				
1800-10	.....	.....	.....	1871	1	.....	1
1811-20	.....	.....	.....	1872	1	2	3
1821-30	3	1	4	1873	1	2	3
1831-40	3	6	9	1874	1	.....	1
1841-50	1	1	2	1875	2	.....	2
1851	.....	.....	.....	1876	2	1	3
1852	.....	.....	.....	1877	1	.....	1
1853	.....	.....	.....	1878	2	.....	2
1854	1	.....	1	1879	.....	2	2
1855	.....	.....	.....	1880	2	1	3
1856	1	.....	1	1881	2	1	3
1857	.....	.....	.....	1882	4	.....	4
1858	2	.....	2	1883	2	2	4
1859	.....	.....	.....	1884	1	1	2
1860	.....	1	1	1885	5	1	6
1861	.....	.....	.....	1886	7	6	13
1862	.....	.....	.....	1887	8	4	12
1863	.....	.....	.....	1888	17	18	35
1864	.....	1	1	Unknown.	2	1	3
1865	.....	.....	.....	Total South'n	73	55	128
1866	.....	.....	.....				
1867	.....	1	1	Total New England.	Main. 254	Subs. 32	286
1868	.....	1	1	" Middle.	406	27	433
1869	.....	.....	.....				
1870	.....	1	1				
Carried fd.	12	13	25				

Subsidiary water-works are those which derive their supply from the mains of some other adjacent works, but are otherwise independent systems. There is but one in the Southern States, Belleville, Ky., included in with the main works.

TABLE 2-C.D.

SOUTH ATLANTIC AND SOUTH CENTRAL STATES WATER-WORKS.—SUMMARY OF CONSTRUCTION BY STATES AND HALF DECADES.

[Date given is that of completion of works.]

DATE	South Atlantic States.							South Central States.						Grand Total.
	Va.	W. Va.	No. Ca.	So. Ca.	Ga.	Fla.	Total.	Ala.	Miss.	La.	Tenn.	Ky.	Total.	
Before 1800	1	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	1
1800-10	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1811-20	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1821-30	1	.....	1	.....	1	.....	3	1	.....	.....	.....	.....	1	4
1831-40	2	1	.....	.....	.....	.....	3	1	.....	1	2	2	6	9
1841-50	1	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	1	1	2
1851-55	.....	.....	.....	.....	1	.....	1	.....	.....	.....	.....	.....	.....	1
1856-60	3	.....	.....	.....	.....	.....	3	.....	.....	.....	.....	1	1	4
1861-65	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	1	1
1866-70	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	2	3	3
1871-75	3	1	.....	.....	2	.....	6	2	.....	.....	1	1	4	10
1876-80	2	.....	2	1	1	1	7	.....	.....	.....	1	3	4	11
1881-85	6	1	3	.....	3	1	14	3	.....	.....	2	1	5	19
1886-88	8	5	5	3	4	9	34	13	3	2	5	6	29	63
Total	27	8	11	4	12	11	73	19	4	3	13	16	55	128

Included in the total of 1886-88 are the following water-works of unknown dates, nearly all of which are known to belong to this period: Virginia 1, South Carolina 1, Tennessee 1.

TABLE 4-C-D.

SOUTH ATLANTIC AND SOUTH CENTRAL STATES WATER-WORKS—SUMMARY BY STATES OF THE MAIN STATISTICS GIVEN IN TABLE 3-C-D.

State.	Pop'n on Water-Works 1880 census.	No. of Works.	Present Finances.		Miles of Mains.	Number of		
			Cost.	Revenue		Taps.	Hydr'ts	Meters.
Virginia	393,883	27	$3,745,482	$296,056	298.05	22,774	1,605	141
West Va	55,691	8	1,282,500	104,300	90.00	9,956	500	2
No. Carolina	52,906	11	1,092,000	179,917	95.55	2,367	621	276
So. Carolina	64,709	4	580,000	113,500	36.35	1,270	394	20
Georgia	193,122	12	2,010,000	233,300	102.75	9,609	1,486	2,344
Florida	25,698	11	875,000	92,021	58.45	2,209	583	306
Total So. Atlantic	536,009	73	$9,784,982	$1,018,582	747.15	48,334	5,249	3,089
Alabama	80,787	19	$3,239,200	$281,845	240.50	7,525	1,591	981
Mississippi	22,006	4	470,000	43,000	32.30	800	277	12
Louisiana	231,206	3	2,747,000	284,400	86.50	5,154	1,372	8
Tennessee	118,163	19	4,080,000	306,985	202.50	14,562	1,240	284
Kentucky	232,055	16	7,510,521	456,308	314.25	22,191	2,391	1,060
Total So. Cent.	684,289	55	$18,133,721	$1,472,538	876.05	50,302	6,871	2,365
Total Southern	1,220,358	128	$27,918,703	$2,491,120	1,623.20	98,636	12,120	5,454
Total Middle	6,165,618	433	156,522,264	15,025,661	7,428.08	880,021	56,066	38,891
Total N. Eng.	2,400,359	287	84,992,725	6,412,624	5,290.70	305,404	32,300	37,913

TABLE 3-C-D.

SOUTH ATLANTIC AND SOUTH CENTRAL STATES WATER-WORKS. MAIN DETAILS BY STATES.

Summarized according to Date of Original Construction, showing the Present Condition of Works started in each Decennial or Quinquennial Period.

[N. B. the figures opposite each date must not be taken as representing the conditions of the works at that date, but merely as the *present condition* of works then existing.]

DATE.	Present pop'n of water-works.	No. of Works. Total.	Present Finances. Cost.	Present Finances. Revenue.	Miles of mains.	Number of Taps.	Number of Hy-dr'ts.	Number of Me-ters.
VIRGINIA.								
1799-50	87,014	5	$1,724,102	$138,474	98.10	10,606	597	69
1851-60	35,965	3	291,132	25,631	27.90	1,713	267	.....
1861-70	.....	.....	.....	.....	.....	.....	.....	.....
1871-80	40,815	5	1,187,748	74,355	70.00	6,100	313	72
1881-85	20,350	6	460,000	29,700	45.75	3,146	236	.....
1886-88	19,216	7	477,500	25,396	53.30	1,129	242	.....
Unkno'n	543	1	5,000	500	3.00	80	10	.....
Total	203,883	27	$3,945,482	$295,056	298.05	22,774	1,665	141
WEST VIRGINIA.								
1854-50	30,737	1	$750,000	$58,000	41.00	6,900	150	.....
1851-60	.....	.....	.....	.....	.....	.....	.....	.....
1861-70	.....	.....	.....	.....	.....	.....	.....	.....
1871-80	6,335	1	85,000	3,500	6.50	650	52	.....
1881-85	6,582	1	106,000	9,500	12.00	680	60	.....
1886-88	12,037	5	341,500	33,300	36.50	1,726	238	2
Total	55,691	8	$1,282,500	$104,300	96.00	9,956	500	2
NORTH CAROLINA.								
1829-50	3,485	1	$4,500	$1,000	2.00	100	9	.....
1851-60	.....	.....	.....	.....	.....	.....	.....	.....
1861-70	.....	.....	.....	.....	.....	.....	.....	.....
1871-80	1,890	2	30,500	1,300	7.80	95	23	80
1881-85	27,208	3	383,000	46,377	29.85	1,126	258	182
1886-88	20,323	5	665,000	131,340	55.90	1,046	322	14
Total	52,906	11	$1,092,000	$179,917	95.55	2,367	621	276
SOUTH CAROLINA.								
1880	49,984	1	$400,000	$91,500	18.00	900	300	20
1881-85	.....	1	.....	.....	.....	.....	.....	.....
1886-88	12,176	.....	160,000	30,000	16.35	320	74	.....
Unknown	2,549	1	20,000	2,000	2.00	50	20	.....
Total	64,709	4	$580,000	$113,500	36.35	1,270	394	20
GEORGIA.								
1828-50	21,801	1	$500,000	$28,843	30.00	1,728	348	.....
1851-60	30,709	1	300,000	49,174	32.60	2,850	312	.....
1861-70	.....	.....	.....	.....	.....	.....	.....	.....
1871-80	42,153	3	548,000	40,551	35.40	2,530	141	2,043
1881-85	28,971	3	501,000	84,580	44.50	2,065	338	296
1886-88	9,308	4	161,000	30,250	20.25	526	147	5
Total	133,122	12	$2,010,000	$233,398	162.75	9,699	1,486	2,344
FLORIDA.								
1880	7,650	1	$112,000	$16,521	8.50	707	100	287
1884-85	1,300	1	50,000	4,700	3.50	275	30	9
1886-88	16,718	9	713,000	71,100	46.45	1,286	453	10
Total	25,668	11	$875,000	$92,321	58.45	2,268	583	306
ALABAMA.								
1825-50	34,109	2	$250,000	$37,100	31.00	1,400	190	1
1851-60	.....	.....	.....	.....	.....	.....	.....	.....
1861-70	.....	.....	.....	.....	.....	.....	.....	.....
1871-80	19,709	2	950,000	102,400	71.00	3,400	332	956
1881-85	1,824	2	115,000	12,500	12.00	400	86	12
1886-88	25,055	13	2,011,200	229,845	136.50	2,325	983	12
Total	80,587	19	$3,326,200	$381,845	240.50	7,525	1,591	981
MISSISSIPPI.								
1867-70	3,985	1	$25,000	$1,500	3.00	200	22	4
1871-80	.....	.....	.....	.....	.....	.....	.....	.....
1881-85	.....	.....	.....	.....	.....	.....	.....	.....
1886-88	18,013	3	445,000	41,500	29.30	690	255	8
Total	22,008	4	$470,000	$43,000	32.30	890	277	12
LOUISIANA.								
1833-40	216,090	1	$2,397,000	$256,600	72.00	4,400	1,191	8
1841-80	.....	.....	.....	.....	.....	.....	.....	.....
1881-85	.....	.....	.....	.....	.....	.....	.....	.....
1888-88	15,206	2	350,000	27,800	14.50	734	181	.....
Total	231,296	3	$2,747,000	$284,400	86.50	5,134	1,372	8
TENNESSEE.								
1832-50	46,750	2	$2,050,000	$88,573	48.50	4,506	344	16
1851-60	.....	.....	.....	.....	.....	.....	.....	.....
1861-70	12,802	1	600,000	21,000	37.50	2,850	150	20
1871-80	37,472	2	895,000	141,000	68.00	4,810	363	245
1881-85	15,070	2	300,000	29,912	27.00	1,376	232	3
1886-88	4,934	5	205,000	21,500	17.50	720	85	.....
Unknown	1,045	1	30,000	5,000	4.00	300	16	.....
Total	118,163	13	$4,080,000	$306,985	202.50	14,562	1,240	284
KENTUCKY.								
1832-50	23,814	3	$71,500	$12,000	12.50	615	9	.....
1851-60	123,758	1	5,008,809	256,556	137.40	11,001	147	678
1861-70	34,814	2	500,000	42,500	38.00	3,280	1,229	28
1871-80	37,259	4	1,210,982	72,677	64.85	5,251	401	166
1881-85	(duplicate)	1	250,000	23,000	17.50	464	232	199
1886-88	12,360	5	469,250	48,975	44.00	1,580	373	9
Total	232,055	16	$7,510,521	$456,308	314.25	22,191	2,391	1,080

TABLE 5-C-D.

SOUTH ATLANTIC AND SOUTH CENTRAL STATES WATER-WORKS—SUMMARY BY DATES OF FIRST CONSTRUCTION OF THE MAIN STATISTICS OF ALL SOUTH ATLANTIC AND SOUTH CENTRAL STATES WATER-WORKS, AS GIVEN IN TABLE 3.

DATE.	Present pop'n of water-works.	No. of Works.	Present Finances. Cost.	Present Finances. Revenue.	Miles of Mains.	Number of Taps.	Number of Hy-drants.	Number of Me-ters.
SOUTH ATLANTIC STATES.								
1799-1850	143,127	8	$2,978,602	$226,317	171.10	19,334	1,004	69
1851-60	66,674	4	591,132	75,805	60.50	4,563	579	.....
1861-70	.....	.....	.....	.....	.....	.....	.....	.....
1871-80	148,827	13	2,372,248	227,627	146.20	10,982	1,238	2,562
1881-85	84,481	14	1,500,000	174,857	135.60	7,202	922	487
1886-88	89,868	32	2,318,000	311,476	228.75	6,033	1,476	31
Unkno'n	3,092	2	25,000	2,500	5.00	130	30	.....
T'l S. Atl.	536,069	73	9,784,982	1,018,582	747.15	48,334	5,249	3,089
SOUTH CENTRAL STATES.								
1825-50	320,763	8	4,768,500	394,273	164.00	10,921	1,734	25
1851-60	123,758	1	5,008,809	256,556	137.40	11,001	147	678
1861-70	51,701	4	1,125,000	65,000	78.50	6,330	1,401	52
1871-80	94,530	8	3,055,982	316,077	203.85	13,461	1,126	1,367
1881-85	16,894	5	665,000	66,012	56.50	2,240	570	214
1886-88	75,598	28	3,480,450	369,620	231.80	6,049	1,877	29
Unkno'n	1,045	1	30,000	5,000	4.00	300	16	.....
T'l, S. C'l	684,289	55	18,133,721	1,472,538	876.05	50,302	6,871	2,365
GRAND TOTALS, SOUTH ATLANTIC AND SOUTH CENTRAL STATES TOGETHER.								
1790-50	463,890	16	7,747,102	620,590	335.10	30,255	2,738	94
1851-60	190,432	5	5,599,941	332,361	197.90	15,564	726	678
1861-70	51,701	4	1,125,000	65,000	78.50	6,330	1,401	52
1871-80	243,357	21	5,428,210	543,704	350.05	24,443	2,364	3,869
1881-85	101,375	19	2,165,000	240,869	192.10	9,532	1,492	701
1886-88	165,466	60	5,798,450	681,096	460 55	12,082	3,353	60
Unkno'n	4,137	3	55,000	7,500	9.00	430	46	.....
Gr'd T'l.	1,220,358	128	27,918,703	2,491,120	1,623.20	98,636	12,120	5,454

N. B.—This table does *not* represent the status of the works at the several dates (except as to number) but the statistics for the *current year* 1888, of works *first opened* at the several dates.

TABLE 6-C-D.

SOUTH ATLANTIC AND SOUTH CENTRAL STATES.—POPULATION STATISTICS IN RESPECT TO WATER-WORKS.

[The "town population" is in towns of 4,000 inhabitants or over]

STATES.	Total Population. 1870	1880	Inc. per cent.	Town Population 1880.	Per cent. of total.	Pop'n on Water-works, 1888. Tot'l 1880 by Census.	P. C. of Total pop'n.	P. C. of Town pop'n.	Av. pop'n on each Water-works.
GROUP C.—SOUTH ATLANTIC STATES.									
Virginia	1,225,163	1,512,565	23.4	178,117	11.8	203,883	13.5	114.4	7,570
W. Virginia	442,014	618,457	39.9	47,846	7.8	55,691	9.0	116.4	6,960
N. Carolina	1,071,361	1,399,750	30.6	40,152	2.9	52,996	3.8	132.0	4,820
S. Carolina	705,606	995,577	41.0	65,189	6.6	64,709	6.5	97.8	16,177
Georgia	1,184,109	1,542,180	30.2	118,980	7.7	133,122	8.6	111.9	11,100
Florida	187,748	269,493	43 5	24,385	9.1	25,668	9.6	105 .3	2,330
Tot. S. Atlantic	4,816,001	6,338,022	31.6	475,660	7.5	536,069	8.5	112.7	7,330
GROUP D.—SOUTH CENTRAL STATES.									
Alabama	996,992	1,262,505	26.6	58,351	4.6	80,787	6.4	138.4	4,250
Mississippi	827,922	1,131,597	36.6	28,084	2.5	22,008	1.9	78.3	5,502
Louisiana	726,915	939,646	29.3	231,236	24.6	231,236	24.6	100.0	77,099
Tennessee	1,258,520	1,542,359	22.5	114,904	7.4	118,163	7.6	102.8	9,080
Kentucky	1,331,011	1,648,690	24.8	231,720	14.1	232,055	14.1	101.4	14,440
Tot. S. Central	5,131,960	6,525,097	27.2	664,355	10.2	684,289	10.5	103.0	12,400
Tot. Southern	9,947,361	12,863,119	58.8	1,140,015	8.9	1,220,358	9.5	107.1	9,530
do. Middle	9,848,413	11,756,053	19.4	5,538,729	47.2	6,165,618	52.5	113.1	14,220
do. New England	3,487,924	4,010,529	15.0	1,989,339	49.6	2,409,359	59.8	120.6	8,391

The apparent large increase of population in the Southern States is to a great extent deceptive, owing to errors of omission in the census of 1870.

TABLE 7-C-D.

SOUTH ATLANTIC AND SOUTH CENTRAL STATES—CLASSIFICATION OF WATER-WORKS BY SIZE OF TOWN IN 1880.

States.	1,000 or under.	1,000 to 3,000	3,000 to 5,000	5,000 to 10,000	10,000 to 20,000	20,000 or over	Total No.
Virginia	6	7	2	4	3	3	25*
West Va	1	2	2	2	.....	1	8
No. Carolina	1	5	2	.....	1	.....	11
So. Carolina	.....	2	.....	.....	1	1	4
Georgia	1	4	1	1	2	3	12
Florida	4	5	.....	2	.....	.....	11
Total So. Atl.	13	25	7	11	7	8	71
Alabama	4	7	3	1	1	1	17*
Mississippi	.....	1	2	.....	1	.....	4
Louisiana	.....	.....	.....	2	.....	1	3
Tennessee	2	4	2	2	1	2	13
Kentucky	3	2	.....	6	1	3	14*
Total So. Cent.	8	14	7	11	4	7	51
Grand Total	21	39	14	22	11	15	122
do Middle	47	174	78	78	24	32	433
do New Eng	40	80	65	48	35	19	287

* 2 duplicate systems in Virginia, 2 in Alabama, and 2 in Kentucky, reduce the totals by so much.

TABLE 8-C-D.

SOUTH ATLANTIC AND SOUTH CENTRAL STATES WATER-WORKS—COST AND REVENUE PER HEAD, TAP, MILE OF MAIN, ETC.

STATE	Cost per			Revenue per			Population on water-works.		P. C. rev. to cost.
	head on water-works.	mile of main.	tap.	head on w'ter w'ks.	mile of main	tap.	per tap.	per meter	
Virginia	$19.37	$13,550	$173	$1.45	$988	$13.00	9.1	1,445	7.48
W. Virginia	23.05	13,370	129	1.88	1,085	10.50	5.6	.....	8.13
No. Carolina	20.60	11,410	460	3.21	1,880	76.00	22.4	192	10.65
So. Carolina	8.97	15,950	456	1.75	3,125	89.00	50.9	.....	19.58
Georgia	15.12	12,340	207	1.75	1,430	24.00	13.7	58	11.60
Florida	34.10	14,960	386	3.59	1,575	40 60	11.3	85	10.53
Av. So. Atlantic	$18.25	$13,070	$202	$1.99	$1,362	$21.00	11.1	173	10.40
Alabama	$41.15	$13,810	$442	$4.73	$1,584	$59.80	10.7	82	11.48
Mississippi	21.40	14,540	529	1.95	1,330	48.30	24.7	.....	9.16
Louisiana	11.87	31,780	536	1.23	3,265	55.50	45.1	.....	10.38
Tennessee	34.50	20,180	280	2.60	1,518	21.10	8.1	417	7.54
Kentucky	32.30	23,900	338	1.96	1,452	20.60	10.5	215	6.04
Av. So. Central	$36.50	$20,650	$360	$2.15	$1,678	$29.20	13.4	289	8.13
Av. Southern	$22.80	$17,180	$283	$2.04	$1,553	$35.30	12.4	224	8.93
do. Middle	25.40	21,000	176	2.43	2,023	16.90	6.9	181	9.40
do. New Eng.	35.30	16,080	269	2.66	1,213	20.30	7 6	63	7.54

TABLE 9-C-D.

SOUTH ATLANTIC AND SOUTH CENTRAL STATES WATER-WORKS.—KIND OF WORKS.

STATE	Gravity	Pumping to				Unkno'n	Total	P. C. gravity works.
		Reservoir.	Tank.	Stand-Pipe	Direct.			
Virginia	8	10	4	2	1	2	27	29.6
W. Virginia	.....	3	2	.....	3	.....	8	.....
No. Carolina	3	3	3	3	.....	.....	12	25.0
So. Carolina	.....	1	1	2	.....	.....	4	.....
Georgia	1	1	4	3	3	.....	12	8.3
Florida	.....	.....	.....	5	3	3	11	.....
Total So. Atl.	12	18	19	13	10	2	74	16.2
Alabama	1	5	2	9	.....	2	19	5.3
Mississippi	.....	2	.....	1	1	.....	4	.....
Louisiana	.....	1	.....	3	.....	.....	4	.....
Tennessee	1	3	2	5	1	1	13	7.7
Kentucky	3	6	1	3	.....	.....	16	19.7
Total So. Cent.	5	17	5	21	5	3	76	8.9
Total Southern	17	35	24	34	15	5	150	13.1
do. Middle	175	116	33	41	40	4	412	42.4
do. New Eng.	130	50	21	31	21	5	258	50.4

As some of the works have a double system, the total exceeds by 2 that of Table 4-B. Several gravity works have small auxiliary pumping systems for special service which have been disregarded. Most of the pumping works pump direct in case of fire.

TABLE 10-C-D.

SOUTH ATLANTIC AND SOUTH CENTRAL STATES WATER-WORKS—SOURCES OF SUPPLY.

STATE.	S'rface	Sp'ngs	Brook	River	Lake	Creek	Wells	Unk'n	T'tal
Virginia	1	12	1	6	2	2	1	2	27
West Virginia	.....	1	.....	7	.....	.....	.....	.....	8
North Carolina	1	3	.....	3	.....	2	3	.....	12
South Carolina	.....	.....	.....	1	.....	.....	3	.....	4
Georgia	.....	2	2	1	.....	1	6	.....	12
Florida	.....	.....	.....	.....	4	1	6	.....	11
Total So. Atl.	2	18	3	18	6	6	19	2	74
Alabama	.....	5	2	3	.....	4	4	1	19
Mississippi	1	.....	.....	1	.....	.....	2	.....	4
Louisiana	.....	.....	.....	2	.....	.....	.....	1	3
Tennessee	.....	4	.....	5	.....	.....	3	1	13
Kentucky	1	3	1	9	.....	1	.....	.....	15
Total So. Cent.	2	12	3	20	.....	5	9	3	54
Total Southern.	4	30	6	38	6	11	28	5	128
Per cent	93.1	23.4	4.7	29.7	4.7	8.6	21.9	3.9	100.0
" Middle	8.3	25.1	10.7	21.6	4.4	14.8	14.1	1.0	100.0
" New Eng	14.0	17.4	16.3	14.0	27.1*	.....	7.7	3.5	100.0

* Including 14.7 per cent. of so called "ponds" really lakes.

TABLE 11-C-D.

SOUTH ATLANTIC AND SOUTH CENTRAL STATES WATER-WORKS—AVERAGE WORKING PRESSURES.

[Representing in some of the gravity works the mean pressure in the mains. In pumping works, however, and in most of the gravity works, the pressure is that at the pumps, or principal mains, and hence, considerably higher than the effective pressure.]

PRESSURE per sq. in.	Va.	W. Va.	N. C.	S.C.	Ga.	Fla.	Tot'l S.Atl.	Al.	M.	La.	Ten.	Ky.	Tot'l So. C.	Gr'd Tot'l
Under 20	.....	.....	1	.....	1	.....	2	.....	.....	.....	.....	.....	.....	2
20-29	2	.....	.....	.....	.....	.....	2	.....	1	1	.....	.....	2	4
30-39	2	.....	1	.....	2	1	6	1	.....	.....	2	2	5	11
40-49	2	3	3	3	3	1	15	3	.....	.....	1	2	6	21
50-59	1	.....	1	.....	1	2	5	3	.....	.....	3	2	8	13
60-69	3	1	1	.....	.....	2	7	1	1	.....	1	1	4	11
70-79	.....	.....	2	.....	3	2	7	2	.....	.....	1	2	5	12
80-89	1	2	2	.....	1	.....	6	2	.....	1	1	1	5	11
90-99	1	.....	.....	.....	.....	.....	1	1	.....	.....	1	.....	2	3
100-109	2	1	.....	.....	.....	.....	3	.....	.....	.....	.....	.....	.....	3
110-119	1	.....	.....	.....	.....	.....	1	1	.....	.....	.....	.....	1	2
120-129	1	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	1	1	2
130-139	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
140-149	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
150-159	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	1	1
160-169	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
170-179	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Total works reporting.	16	7	11	3	11	8	56	14	2	2	10	12	40	96
	Average Pressure, lbs.						62.0	Average Pressure, lbs.					66.2	
	" New England						72.5	" Middle States					68.3	

TABLE 12-C-D.

FIRE PRESSURE OF SOUTH ATLANTIC AND SOUTH CENTRAL STATES WATER-WORKS, WHEN THE SAME ARE HIGHER THAN THE NORMAL WORKING PRESSURES.

[Nearly all the following are pumping works, but there are a few gravity works which are able to turn on a higher fire pressure from higher reservoirs.]

FIRE PRESSURE lbs. per sq. in.	Va.	W. Va.	No. Ca.	So. Ca.	Ga.	Fla.	To'al So. Atl.	Al.	M.	La.	T'n	Ky.	Tt'l S.C.	Grand Total.
30-39	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
40-49	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
50-59	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	1	1
60-69	1	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	1
70-79	.....	.....	1	.....	.....	.....	1	.....	.....	.....	.....	1	1	2
80-89	.....	2	.....	.....	.....	.....	2	.....	.....	.....	.....	.....	.....	2
90-99	1	1	.....	.....	1	.....	3	3	1	.....	.....	4	.....	7
100-109	1	.....	3	.....	1	2	7	2	.....	.....	2	1	5	12
110-119	.....	.....	.....	.....	1	1	2	1	.....	.....	1	.....	2	4
120-129	2	.....	1	.....	1	.....	4	.....	.....	.....	.....	1	1	5
130-139	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
140-149	2	.....	.....	.....	.....	.....	2	.....	.....	.....	.....	.....	.....	2
150-159	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	1	2
160-169	.....	.....	.....	.....	.....	1	1	.....	.....	.....	.....	.....	.....	1
170-179	.....	.....	.....	.....	.....	1	1	.....	.....	1	1	1*	3	4
Total works reporting.	7	3	5	0	4	5	24	7	1	1	4	5	18	42

*200 lbs.

AMOUNT OF INCREASE ABOVE NORMAL PRESSURE.

10 lbs. or under.	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	1	1
10-19	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	1	1
20-29	.....	1	.....	.....	1	1	3	.....	.....	.....	1	.....	1	4
30-39	1	.....	2	.....	1	.....	4	.....	1	.....	.....	1	2	6
40-49	1	1	1	.....	.....	.....	3	3	.....	.....	.....	.....	3	6
50-59	.....	1	2	.....	.....	.....	3	1	.....	.....	2	.....	3	6
60-69	3	.....	.....	.....	.....	2	5	1	.....	.....	.....	1	2	7
70-79	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	1	2	3
80-89	2	.....	.....	.....	2	.....	4	.....	.....	.....	.....	.....	.....	4
90-99	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	1	1
100-109	.....	.....	.....	.....	.....	1	1	.....	.....	.....	1	.....	1	2
110-119	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1*	1	2
120-129	.....	.....	.....	.....	.....	1	1	.....	.....	.....	.....	.....	.....	.....
Total works reporting.	7	3	5	0	4	5	24	7	1	1	4	5	18	42

*149 lbs.

TABLE 13-C.

OWNERSHIP OF SOUTH ATLANTIC STATES WATER-WORKS, WITH POPULATION SUPPLIED BY PUBLIC WORKS, ETC.

	Va.	W. Va.	No. Ca.	So. Ca.	Ga.	Fla.	Total.
City or town	21	5	2	3	8	2	41
Local company	6	3	8	1	4	8	30
Outside company	.....	.....	1	.....	.....	.....	1
Individuals	.....	.....	.....	.....	.....	1	1
Unknown	.....	.....	.....	.....	.....	.....	.....
Total No.	27	8	11	4	12	11	73
Population supplied by public works	168,324	47,506	3,166	14,725	101,260	10,212	345,193
P. C. of pop'n supplied by city works	82.7	85.3	5.9	22.7	76.0	39.7	64.4
Pop'n on private works	35,559	8,185	49 839	49,984	31,862	15,456	190,876
Pop'n per private work	5,9	2,728	5,537	49,984	7,965	1,717	6,000
P. C. of census city pop'n supplied by public works	94.4	99.4	78.8	22.2	85.0	41.8	72.6

TABLE 13-D.

SOUTH CENTRAL STATES.

	Ala.	Miss	La.	Tenn.	Kent'y	Total.	Total S. Atl. So. C.
City or town	3	1	.....	2	7	13	54
Local company	15	3	3	11	9	41	71
Outside company	.....	.....	.....	.....	.....	.....	1
Individuals	1	.....	.....	.....	.....	1	2
Unknown	.....	.....	.....	.....	.....	.....	.....
Total No.	19	4	3	13	16	55	128
Population supplied by public works	8,153	3,995	.....	48,727	86,290	14 ,165	492,358
P. C. of pop'n supplied by city works	10.4	18.2	0.0	41.2	37.2	21.5	39.5
Pop'n on private works	72,634	18,013	231,296	69,436	145,745	537,124	728,000
Pop'n per private work	4,830	6,004	77,100	6,494	16,194	13,080	9,840
P. C. of census city pop'n supplied by public works	14.0	14.0	0.0	42.3	37.3	22.1	43.2

TABLE 14-C.D.

SOUTH ATLANTIC AND SOUTH CENTRAL STATES WATER-WORKS REPORTING OVER 100 METERS IN USE.

CITIES WITH OVER 100 METERS.		SUMMARY OF ALL METERS.						
			South Atlantic.		South Central		Total.	
			Works.	Meters.	Works.	Meters.	Works.	Meters
Wilmingt'n, N.Ca.	120							
Atlanta, Ga	2,000							
Macon, "	248							
Jacksonville, Fla.	287							
	2,605	Over 100	4	2,655	5	2,073	9	4,728
		Under 100	17	234	19	292	36	526
Birmingham, Ala.	200	None	52	.....	31	.....	83	.....
Montgomery, "	756							
Memphis, Tenn.	240		73	2,889	55	2,365	128	5,254
Louisville, Ky	678							
Lexington, "	199	In Middle States						34,056
	2,073	In New England						37,913

TOWNS HAVING OVER ONE-SIXTH OF THEIR TAPS METERED.

	p. c. metered.		p. c. metered.
Salem, N. C.	94.0	Jacksonville, Fla.	40.6
Wilmington, N. C.	34.7	Montgomery, Ala.	54.0
Winston "	35.8	Louisville, Ky	11.2
Atlanta, Ga	100.0	Lexington, "	43.1
Macon, "	24.4		

TABLE 16-C-D.

SOUTH ATLANTIC AND SOUTH CENTRAL STATES WATER-WORKS.—PUMPING MACHINERY.

Makes of Pumps (arranged alphabetically.	No. of Pumps.			Capacity, millions of gallons.				
	South Atlantic.	South Central.	Total.	South Atl'n'c	South Centr'l	Total South.	Total Middle	T'tal N. E.
Blake	5	17	22	4.2	34.2	38.4	26.1	21.4
Cameron	.....	.....	.....	.....	.....	.....	1.6	.....
Corliss	.....	.....	.....	.....	.....	.....	22.0	20.0
Cornish	.....	.....	.....	.....	.....	.....	19.3	9.0
Davidson	.....	2	2	.....	5.0	5.0	28.7	12.5
Deane	12	14	26	13.6	29.6	43.2	19.4	30.5
Galloway	.....	.....	.....	.....	.....	.....	6.0	.....
Gordon & Maxwell	7	5	12	5.1	7.5	12.6	8.5	.....
Holly-Gaskill	11	20	31	21.0	60.0	81.0	156.9	17.5
Knowles	7	5	12	8.9	9.1	18.0	32.1	19.5
Laug	.....	.....	.....	.....	.....	.....	8.2	6.5
Lowery	.....	.....	.....	.....	.....	.....	10.0	.....
Smith & Vaile	4	.....	4	4.0	.....	4.0	.....	.....
Volker & Feithousen	.....	.....	.....	.....	.....	.....	5.5	.....
Wetherill	.....	.....	.....	.....	.....	.....	12.0	.....
Wood	1	.....	1	5.0	.....	5.0	6.0	9.5
Worthen	.....	.....	.....	.....	.....	.....	5.5	.....
Worthington	25	11	36	39.9	47.5	87.4	344.6	123.8
Wilson & Snyder	1	.....	1	1.0	.....	1.0	0.6	.....
Miscellaneous	12	16	28	37.3	33.2	70.5	262.2	62.9
Totals	85	90	175	140.0	226.1	366.1	961.2	342.1

Max J. Becker, President Am. Soc. C. E.

(WITH PORTRAIT.)

MAX J. BECKER, the recently elected President of the American Society of Civil Engineers, was born at Coblenz, in Rhenish Prussia, on June 1, 1827.

He was educated at the college of his native city, in which institution his father was at that time a teacher.

In 1846 he obtained permission from the Department of Public Works to serve as volunteer apprentice upon the staff of the chief engineer, in charge of extensive locks and canals for the improvement of navigation on the river Luhn, a tributary of the Rhine, with headquarters at Wetzlar.

An apprenticeship of this kind, under a Government engineer or surveyor, was at that time required as a preparatory step for admission to the Royal Academy at Berlin, which was then the only Polytechnic school under control of the Prussian Government, from whose graduates the official positions in the various departments of public works were supplied.

While thus employed as engineer-apprentice on the improvements of the river Luhn, Mr. BECKER was offered a position in the locating corps of the Cologne-Minden Railroad, which he promptly accepted.

This was in the year 1847, when railway building was in its infancy, and when a position on an important line of railway was considered a sufficient inducement to sacrifice the assured certainty of future Government service, with its slow promotions, for the far more promising prospects in the employ of private corporations.

During the remainder of the year 1847, Mr. BECKER was attached to several locating parties between Dusseldorf and Bielefeld, and in 1848 he was made assistant engineer in charge of construction of a division, with headquarters at Hamm in Westphalia, at which point he took special supervision of the construction of a large stone arch bridge across the River Lippe.

Early in 1849, the political disturbances which had agitated Europe for a year previously, and in which Mr. BECKER, together with a large number of young men, had taken a more or less active part, assumed the proportions of an open, armed revolution, the disastrous termination of which landed him with the rest of his comrades in Switzerland, where he remained in exile until his emigration to this country in May, 1850.

After a rather severe struggle for existence, accompanied by many hardships and privations, he succeeded, in the spring of 1851, in finding employment upon a topographical and geological survey of parts of Connecticut, until he was induced, in December of 1851, by a former friend and schoolmate, to go to Ohio and take service under Mr. JACOB BLICKENSDERFER, M. A. S. C. E., who was then Chief Engineer of the Steubenville & Indiana R. R. Co., the original predecessor of the present Pittsburg, Cincinnati & St. Louis Railway Company. There he served as draughtsman, topographer, and assistant engineer in charge of construction until the completion of the line in 1855.

From 1856 to 1858 he served as engineer of the Board of Public Works of the State of Ohio, and from 1859 to 1861 he was engaged on the Marietta & Cincinnati Railroad, in revising the location of the eastern part of its line, and in preliminary surveys for its western extension.

During the year 1862 he returned temporarily to the Pittsburg, Cincinnati & St. Louis Railway and took charge of the construction of the Ohio River bridge at Steubenville, which was the first railway bridge crossing that river. In 1863 he returned to the Marietta & Cincinnati Railroad, and during the years 1864 and 1865 built its western extension from Loveland to Cincinnati, and in 1866 he made a series of surveys for railways in the petroleum fields of western Virginia.

Early in 1867 he was appointed Chief Engineer of the Pittsburg Cincinnati & St. Louis Railway, which office he now holds, and which was gradually extended to embrace the various lines acquired by leaseholds, purchases, and additional construction, until it now comprises a system of about 1,600 miles of railroad, extending through the States of Pennsylvania, West Virginia, Ohio, Indiana, Illinois, and Kentucky. Upon the lines under his charge are

four large bridges over the Monongahela and Ohio rivers at Pittsburg, Steubenville, Cincinnati and Louisville, and the projected bridge across the Ohio river below Pittsburg, for the Ohio Connecting Railway, is also under his charge.

Mr. BECKER was elected a member of the American Society of Civil Engineers August 7, 1872. He is also a member of the Engineers' Society of Western Pennsylvania, of which Society he has been Vice-President and is now a Director.

PERSONAL.

Mr. C. W. LEWIS was recently appointed City Engineer of Houston, Tex.

Mr. ELIJAH SMITH, has been appointed President of the Seattle, Lake Shore & Eastern.

Mr. GEO. E. WAITE has been appointed Superintendent of the New York, Susquehanna & Western, vice Mr. C. D. MCKELVEY resigned.

Capt. H. H. TATEM has been appointed Treasurer of all the roads in the Queen and Crescent system, with the exception of the Vicksburg & Meridian.

Mr. H. C. BOMBERGER has been appointed Acting Superintendent of the Harrisburg & Potomac, with headquarters at Boiling Springs, Pa. This is one of the lines controlled by the Philadelphia & Reading.

Mr. W. M. HUGHES, of Cleveland, O., Bridge Engineer in the City Civil Engineer's department, has resigned to accept the position of Assistant General Manager of the Keystone Bridge Works, at Pittsburg, Pa.

Mr. P. D. FISHER, Consulting Engineer of the Lake Erie & Western, died recently. Mr. FISHER had been Chief Engineer of the Kansas Pacific, the Columbus & Hocking Valley, and the Toledo, Delphos & Cincinnati.

Mr. F. S. GRANGER has been appointed Assistant Superintendent of the Southern division of the Chicago, Burlington & Quincy, with headquarters at Edgar, Neb. E. F. HIGHLAND has been appointed Roadmaster, with headquarters at Nebraska City, Neb. C. W. HOHANS, Roadmaster, has had his division extended, and his headquarters are at Tecumseh, Neb.

Mr. JOB ABBOTT, President of the Dominion Bridge Co., Limited, of Montreal, Canada, and also President of the Wheeling Railway Bridge and Terminal Co., of Wheeling, W. Va., has opened an office at 150 Broadway, New York. He will be in the Wheeling office from the 2d to 5th and at the Montreal office from the 14th to 17th of each month.

Mr. THOMAS TAIT has been appointed Superintendent of the Ontario division of the Canadian Pacific: Mr. T. WILLIAMS, Assistant Superintendent, Ontario & Quebec section; Mr. J. W. LEONARD, Assistant Superintendent, Credit Valley section, offices at Toronto. The Ontario & Quebec section will include the Toronto, Grey & Bruce, Teeswater branch and the line east from Toronto Junction to Montreal Junction. The Credit Valley section will include the line west to St. Thomas, the London, Guelph, Orangeville and Elora branches, also Toronto Junction, Parkdale, Queen's Wharf and Union Stations.

SOCIETY PROCEEDINGS.

Asrican Society of Civil Engineers.—The regular meeting of the society was held Feb. 6, Past Vice President THOMAS J. WHITMAN, of St. Louis, in the chair.

The secretary read a summary of a table prepared by Mr. G. LEVEZICH giving details of the cost of operation by horse power of the street railways in New York and Brooklyn. He also read a paper by Mr. HENSHAW in connection with the paper on River Improvement, which was presented by Col. CRAIGHILL at the last annual convention. Mr. HENSHAW's paper recommended training walls of loosely woven, flexible mat rial, such as osier willows, for the purpose of giving a permanent channel to such rivers as the Mississippi. Lateral fences of similar construction would connect these lines with the shore, and would cause material in suspension to be deposited on either side of the channel. Short lateral spurs would also project into the channel to prevent scour at the sides.

There was considerable discussion over an open ballot which had been taken for the reconsideration of the application of a rejected candidate for membership. This was the first case under the new amendment of the constitution, and its decision was important as forming a precedent. It was claimed that the candidate should have been posted for 30 days for this reconsideration, as on the first application. It was finally decided to refer the special ballot to the Board of Directors for reconsideration.

The Secretary announced the deaths of the following members: HENRY D. BLUNDEN, of Athens, Pa., on Jan. 7; N. W. ELLIS, of Manchester, N. H., Jan. 16; LOUIS LESAGE, of Montreal, Canada, Jan. 9; and S. M. FELTON (Fellow), Philadelphia. The election of J. J. HILL of St. Paul, Minn., as Fellow, was also announced.

The following candidates were declared elected:

Members.

SAMUEL LISPENARD COOPER, Yonkers, N. Y.; SOREN T. M. B. KIELAND, Buffalo, N. Y.; SAMUEL CLARENCE THOMPSON, New York City; FRANK HERBERT TODD, St. Cloud, Minn.; SCHUYLER SKAATS WHEELER, New York City.

Associate.

JONES FREDERICK LEWIS, New York City.

Juniors.

JONES BENTON FRENCH, Philadelphia, Pa.; GEO. KING MCCORMICK, Johnson City, Tenn.

Engineers' Society of Western Pennsylvania.—The ninth annual meeting was held at Pittsburg, Pa., on Jan. 22. The reports of the officers showed the Society to be in good condition. The retiring president, A. E. FROST, read his address. The following officers were elected: JOHN BRASHEAR; Vice President, A.E. HUNT, Jr.; Directors, WM. METCALF and M. J. BECKER; Secretary, Col. S. M. WICKERSHAM; Treasurer, A. E. FROST.

RAILWAYS.

EAST OF CHICAGO.—Existing Roads.

Pennsylvania, Poughkeepsie & New England.—Andrews & Warner have completed 6 miles of grading on this line within the past 6 weeks, from Pine Island, N. Y., to a connection with the old grade near Deckertown, N. J. They have now taken the contract for grading the line from Portland, Pa., to the end of the old grade near Deckertown, a distance of about 30 miles. JOHN R. LEE of Paterson has the contract for ballasting and tracklaying. The contractors for the whole line are Wm. Baird & Co., the builders of the Poughkeepsie bridge.

Cornwall.—The surveys in progress between Cornwall, Pa., and Lancaster, and Cornwall and Middletown, which were credited to the Cornwall & Lebanon Co. in last week's issue, should have been credited to this company, which is at work on the lines with the intention of connecting with the Pennsylvania R. R. system.

Toledo, Columbus & Southern.—The motion to set aside the sale of this Ohio road has been denied, and Judge JACKSON has directed the receiver to turn the property over to the purchasers. The case has been appealed to the United States Supreme Court.

Hudson Connecting.—Rapid progress is being made on this road, 27 miles in length, from Campbell Hall, N. Y., to the west terminus of the Poughkeepsie bridge. Contracts have been let for building 7 passenger stations for the road, and a tract of land of 150 acres at Campbell Hall has been purchased for sidings and storage tracks to accommodate 1,000 cars, and for a round-house and the company's offices. The road will probably be open for traffic by June 1.

Baltimore & Drum Point.—Contractor M. C. MEIGS has purchased 8,000 tons of 60-lb. steel rails, to be delivered in Baltimore during the months of March, April, and May. About 50 miles of roadbed are graded and 700 hands are now at work on the 30 miles remaining.

Baltimore & Ohio.—Right of way has been secured for the 2-mile branch to connect with the Baltimore & Sparrow's Point Railroad.——It is deemed certain that THOS. M. KING will return to take the Second Vice-Presidency of the company.

Wheeling & Lake Erie.—Miller & McCann, contractors on the extension from Bowerston, O., to Wheeling, report good progress on the 800 ft. tunnel. The masonry work is delayed, however, as the stone cannot be drawn from the quarries while the roads are so muddy.

Buffalo, Rochester & Pittsburg.—A special meeting of the Lincoln Park & Charlotte Co. will be held on Feb. 13 to consider the proposition to issue bonds to the amount of $300,000 on the property and to lease it to this company. The general offices of the Buffalo, Rochester & Pittsburg are to be removed from Buffalo to Bradford, Pa., on March 1.

Western Maryland.—The work on the extension at York, Pa., to connect with the York & Peach Bottom road, control of which was recently secured, was interrupted by employés of the Northern Central railroad of the Pennsylvania system. The Western Maryland workmen began excavating for a cut by which they were to pass beneath the Northern Central tracks; but as fast as they shoveled the dirt out, the Pennsylvania men shoveled it back. After a couple of days or so of this work, the matter was amicably settled.

Boston & Albany.—The company has made formal application to the Massachusetts Legislature for permission to increase its capital stock from $20,000,000 to $30,000,000. $7,000,000 will be used to take up the same amount of maturing bonds and the remainder for removing grade crossings and making permanent improvements to the line.

Housatonic.—The hearing before the Connecticut Legislature on the application to increase the capital stock of this company has been postponed. It is stated that this company intends to back the New York & Connecticut Air Line project, a proposed parallel to the New York, New Haven & Hartford.

Canadian Pacific.—Regular trains on the Atlantic and Ontario divisions began using the new Montreal station on Feb. 4, at the date of opening of the Montreal carnival.——President VAN HORNE has replied to the recent memorial, drawn up by English shareholders of the Canadian Pacific and the Grand Trunk, urging the importance of harmonious relations between the two companies. He states that the two companies have always worked harmoniously in the matter of rates, and that the wholesale cutting of rates which has brought neighboring American lines close to bankruptcy has been almost unknown between the two great Canadian companies.

It is then stated that the territorial policy adopted by the company in 1882 contemplated the securing of a system of railways in Ontario which should render the company independent in its traffic between Ontario and the Canadian Northwest. This contemplated system is now near completion, and the link from London to Windsor is declared to be a necessary one to give direct connection with the important American systems at Detroit. The negotiations with the Grand Trunk managers for a trackage right over their line is described, and the reasons are stated why the Canadian Pacific managers deemed it best not to accept the terms offered. "Whether or not the recent absorption of the Northern & Northwestern Railways by the Grand Trunk," says President VAN HORNE, "will involve the construction by the Canadian Pacific of a line of its own from Toronto to Sudbury, will depend entirely upon the policy of the Grand Trunk in regard to Ontario traffic to and from the Canadian Northwest. The Canadian Pacific Company has no desire to make this line, and will not do so unless it should become absolutely necessary to the protection of its interests."

Contracts for the extension from London to Windsor have been let. Angus Sinclair, of Chatham, and Wm. Doherty, of Montreal, have the 50 miles from Windsor to near Chatham. The next section of 10 miles is awarded to Wm. Brown, of Chatham; and the next 10 miles to Hickson & Hutchinson, of St. Catherine's.

Delaware & Hudson Canal Co.—The directors have voted to increase the dividend rate of this company from 6 to 7 per cent. per annum.

Green Ridge.—This Maryland railroad was opened for public traffic on Jan. 1. It has heretofore been operated as a lumber road. It extends from Finksburg to Okonoko, 16 miles. F. MERTENS is President, and JOHN H. MERTENS, General Manager. The offices are at 52 South Center St., Cumberland, Md.

Projects and Surveys.

West Side.—Incorporated in New Jersey, with a capital stock of $500,000, to build a line of double-track railway from the foot of St. Paul's Ave., Jersey City, south to Bergen Point, crossing the tracks of the Pennsylvania and the Newark & New York roads, and the Morris canal, and passing through Bayonne, near Avenue A. The road is intended to furnish transit facilities to the western slope of Jersey City Heights. The officers of the company are: G. W. HELM, President; H. W. DOTTY, Vice President; GEORGE HOLMES, Secretary; and F. H. EARLE, Chief Engineer.

Oneonta & Richfield Springs.—Incorporated in New York to build a railway from a point on the Delaware, Lackawanna & Western R. R., in or near Richfield Springs to a point on the Delaware & Hudson Canal Co.'s R. R., in or near Oneonta, a distance of about 32 miles. The capital stock is $320,000. Among the incorporators are RUFUS P. LUCE, C. E. NEWMAN, W. C. CULVER of New York, and J. A. WESTERVELT of Jersey City.

Dayton & Lebanon.—Articles of incorporation have been filed for the construction of a railway between Dayton, O., and Lebanon, O. A survey of the line will be begun soon and if local aid can be secured, the construction will follow at once. Among the incorporators are WM. HUFFMAN, G. B. HARMON, G. W. HOUCK, and W. P. CALLIHAN. The capital stock is $500,000.

Brighton, Warkworth & Norwood.—It is reported that this company will commence work on its road soon. The road is to run from Presque Isle harbor via Brighton, Ont., to Norwood, Ont., where it will connect with the Canadian Pacific.

Maine.—A bill will be presented to the present session of the Maine Legislature granting FRANK JONES of Portsmouth, N. H., Hon. ARTHUR SEWALL of Bath, Me., JOHN AYER of Oakland, Hon. E. F. WEBB of Waterville, F. W. HILL of Bangor, and A. W. HALL of Sherbrooke, P. Q., a charter to build a railway from a point on the Quebec Central, in the northwest part of the State, crossing the Canadian Pacific at Moose river and connecting with the Somerset R. R. at Embden, and extending also from Oakland to the seaboard at Wiscasset.

Ossining.—The survey has been made for this New York road, which is to run from Whitson's station to Sing Sing, 3¼ miles. J. C. COCKCROFT of Sing Sing is President, and THOMAS STRATFORD is Chief Engineer. The company was incorporated March 24, 1888.

Plymouth & Fremont.—This is a rival project to the Plymouth & Sandwich, mentioned two weeks ago; and the intention is to construct a line of railway from Plymouth, Mass., via Carver and South Plympton to Tremont, about 14 miles. It is claimed that this line will cost less than the Plymouth & Sandwich and will pass through a better paying section.

Barnegat Park.—This company has been organized in New Jersey with the following officers: JOHN B. LAMER of Washington, D. C., President; EDWARD S. FARROW, U. S. A., Vice President; and WM. L. BRUEN, Secretary

and Treasurer. The road is to be run in connection with the Pennsylvania and the New Jersey Southern, at or near Barnegat beach.

Montpelier & Chicago.—A project is on foot to build a line of railway from Montpelier, Ohio, to Chicago Right of way has been secured over the old Canadian Southern roadbed as far as Steubenville, Ind. The officers are: DAVID STAUFFER, President; A. H. BALDWIN, Vice President; JACOB LEW Treasurer, and GEO. STRAYER, Secretary, all of Montpelier.

SOUTHERN—Existing Roads.

Columbus Southern.—About 500 hands are grading this Georgia road, extending from Columbus to Albany, 87 miles, and have the work about half finished. The contract date for completion is November, 1889; but it is expected to have the road completed considerably before that time.

Cincinnati, New Orleans & Texas Pacific.—The directors of this company have declared a dividend of 3 per cent. on the stock. This is the third dividend declared by the company since its organization. One of 1½ per cent. was paid Jan. 14, 1882, and one of 3 per cent. was paid Jan. 13, 1883. The directors voted to change the date of ending of the company's fiscal year to June 30, in accordance with the recommendation of the Interstate Commerce Commission.

Vicksburg & Meridian.—This road was sold at foreclosure sale this week to CHAS. SCHIFF, EDWARD COLSTON, W. L. NUGENT, J. F. WINSLOW, and others, representing the managers of the Queen & Crescent system.

Richmond & West Point Terminal.—The reference in our last week's editorial to the probable alliance between this system and GOULD'S Missouri Pacific receives quick confirmation. It is publicly announced that the east-bound business of the Gould system is to be directed as far as possible over the Richmond Terminal lines, making connection at Memphis and at Arkansas City. GOULD and his sons now hold about 50,000 shares of Richmond Terminal stock, and GEORGE GOULD has recently been chosen a director of the Richmond Terminal Co.

President INMAN has replied to the projectors of the Washington & Ohio Railroad, who have been trying to induce the Richmond Terminal to back their enterprise, stating that the company does not care to undertake so expensive a line at present.

Central Railroad of Georgia.—About 12 miles of track has been laid on the extension of the Buena Vista & Ellaville to Columbus, Ga. Work on the remaining 26 miles is progressing rapidly.

Memphis & Charleston.—A branch 1¼ miles in length is to be built to New Decatur, Ala. The line is located, and the contract for grading has been let to J. T. Cross.

Jacksonville, Tampa & Key West.—The bridge across the St. John's river at Palatka, Fla., is completed. The pile trestle work was 4,000 ft. long and the draw span is 230 ft. long. T. H. BROWN and F. A. VON EBERSTEIN were the contractors.

Suwanee River.—Grading is in progress on an extension of 12 miles from Hudson, Fla., south.

Atlantic & No. Carolina.—A strong movement is in progress to extend this North Carolina road from Goldsboro to Raleigh, about 50 miles. The people along the line are taking much interest in the extension and will contribute heavily toward it. WASHINGTON BRYAN, Newbern, N. C., is President.

Charleston, Cincinnati & Chicago.—A report from Johnson City, Tenn., states that Shea & McDonald of Knoxville have received the contract for building the division of this road from Johnson City to the Cumberland river.

Lynchburg & Durham.—Bonds for the completion of this road have been floated in Philadelphia, and the remainder of the line is to be put under contract at once.

Kentucky Midland.—Tracklaying has begun on this road at Frankfort and at Georgetown.

Atlanta & Florida.—President AARON HAAS proposes to build a branch from Knoxville, Ga., to Macon, about 23 miles. The project points to an alliance between the company and the Georgia Southern & Florida.

Natchez, Jackson & Columbus.—At the annual meeting of this Mississippi company, T. J. NICHOLL of Natchez was elected President and General Manager and G. H. CANDEE of New York City, Vice-President. No action was taken toward raising funds to widen the gauge of the road.

Kentucky.—The annual report of the State Railroad Commission shows gross earnings of all the roads in the State for the year to be $14,583,075 against $12,433,906 in the preceding year, an increase of nearly 28 per cent. The commission state that 200 miles of roads are now under contract and 500 miles are projected with fair prospects of construction.

Louisville, St. Louis & Texas.—It is proposed to extend this road from Henderson to Paducah, Ky., and subscriptions in aid of the work will be obtained from the counties along the line.

Alabama Midland.—Two steam pile drivers are at work putting down piles for the bridge at Bainbridge, Ga. The company has received rails for the first 25 miles and is now laying them as rapidly as possible. Four locomotives from the Baldwin works have been delivered at Bainbridge, and the first division of the road will be opened for traffic as soon as possible.

Americus, Preston & Lumpkin.—President S. H. HAWKINS writes as follows:

The Directors of the A. P. & L. R. R. resolved at their meeting on Jan. 28 to accept at once the charter recently granted by the Georgia legislature changing the corporate name to "The Savannah, Americus & Montgomery Railway," also to use heavy equipment in widening present gauge; also to build east from Abbeville to E. T. V. & G. R. R., a distance of 25 miles; also to issue 30 year, 6 per cent. bonds at the rate of $12,000 per mile on its present completed road and on such extensions as may be made.

Empire & Dublin.—J. C. ANDERSON, of Chattanooga, Tenn., is President of the Empire Lumber Co., which is to build this road from Hawkinsville to Dublin, Ga., about 42 miles. Work is to begin about March 1.

Clarksburg, Weston & Glenville.—This West Virginia road, 25 miles in length, is to be changed to standard gauge during the coming summer. A. H. KUNST of Weston, W. Va., is President.

Owensboro, Falls of Rough & Green River.—Ground was broken on this road at Owensboro, Ky., on February 2, and contractors Schafer & Nichols have a large force at work. Grading camps have been established all along the line to a point some distance beyond Whitesville. C. H. DISHMAN is Chief Engineer.

Projects and Surveys.

Leesburg & Lake Region.—Mr. JOHN F. RICHMOND, President of this company, writes us as follows:

This road is to run from Stewart's Landing, on Lake Apopka, via Yalaha, Bloomfield, Parkland, and Riverside to Leesburg, with a branch from Riverside via Okahumpka, Sumterville and, Panasoffkee to the Withlacoochee river, with a possible extension to the Gulf, from 80 to 100 miles. The surveys have all been made. The route, as surveyed, is through a rolling pine wood country, with slight elevations and depressions, affording easy grades and light work. The company was incorporated in 1888. C. S. NOBLE is Chief Engineer.

North Carolina.—Bills have been introduced into the North Carolina Legislature to incorporate the Milton & Yanceyville R. R. Co. and the Ocean View R. R. Co.

Heflin & Carrollton.—It is stated that an application will be made to the coming session of the Alabama Legislature for a charter to build a line of railway from Heflin, Cleburne Co., Ala., to Carrollton, Ga., passing through the Arbacoochee mineral region, rich in mines of iron, mica, and kaolin. The road will be about 65 miles long.

Nashville & Charleston.—It is reported that a project, backed by a syndicate of Pennsylvania and Kentucky bankers and capitalists, is on foot to build the above named road. The road, as projected, will enter Tennessee via the Little Tennessee river, crossing the Great Smoky Mountains and passing through the rich iron fields of Monroe county.

Griffin.—It is reported that surveys are being made for a narrow-gauge railway, to run from Anderson, W. Va., to the Griffin brown-stone quarries. A. H. HARRISON is Chief Engineer.

THE NORTHWEST—Existing Roads.

Centralia & Ste. Genevieve.—The first locomotive for this Illinois road arrived on January 29, and steel rails enough have been delivered to lay the track from Sparta, Ill., to the Cairo Short Line. Construction is to be rapidly pushed, and it is hoped to have the line ready for traffic by the end of the month.

Cairo, Vincennes & Chicago.—A report is published that this company intends to build an extension from Vincennes to Indianapolis to parallel the I. & V. R. R., a part of the Pennsylvania system. The report seems entitled to little credence.

Duluth & Winnipeg.—There seems to be a strong movement on foot to obstruct this company in obtaining possession of its land grant. The injunction brought by the Duluth, Brainerd & Northwestern Co. has been dissolved, but the Legislature has bills before it to forfeit the grant and there will be a hard fight to carry them.

Chicago & Northwestern.—The projectors of the proposed extension from Janesville to Lake Geneva, Wis., have received a final refusal from the company's officers, who state that they do not think it for the company's interest to build the line at present.

Winona & Southwestern.—Regular trains began running between Winona and Bear Creek on January 31. Chief Engineer WHEELER is actively at work on the surveys in Iowa.

Chicago, St. Paul & Kansas City.—A projected branch in Minnesota is to extend from a point near Eden, Dodge county, via Wasioja and Mantorville to Rochester. ——The Central Iowa will probably be formally transferred to the company on March 1.

Northern Pacific & Manitoba.—The Railway Committee of the Canadian Government have granted permission to the company to cross the Canadian Pacific lines at Morris. The Canadian Pacific representatives denied the right of the road to make the crossing even with the consent of the Committee, and have filed a bill in chancery asking the court to restrain the Northern Pacific & Manitoba Railway Co. from operating or continuing the construction of that road, on the ground that the local legislature cannot enact legislation regarding a railway connecting at the boundary line with a foreign railway; also on the ground that any Legislation of the local Legislature is *ultra vires* which provides for a railway crossing the Canadian Pacific railway or its branches, they being declared works for the general advantage of Canada.

St. Paul & Duluth.—The company has received notice from the Secretary of War ordering the early completion of the work at the Grassy Point bridge necessary to the removal of all obstructions to navigation. This will include the dredging of a new channel and the building of a 500 ft. boom. The law provides that the Secretary of War shall exact a penalty of $500 a month after a reasonable time has been allowed for the work.

Illinois Central.—The Chicago, Madison & Northern is now in operation from Madison, Wis., to Clyde, Ill., six miles west of Chicago. Right of way has been obtained and it is expected soon to begin work on the extension to connect it with the main line terminals on the lake front.——During the past six years the following permanent improvements have been made and paid for out of net income: 44,272 tons of steel rails, 389 miles of ballasting, 5,184 lineal ft. of iron and steel bridges, 35 miles double tracking, 88 miles of sidings, and 57 heavy locomotives. General Manager JEFFERY says the physical condition of the system is better now than ever before.

Green Bay, Winona & St. Paul.—Goodyear & Sons of Black River Falls, Wis., propose to build a short branch from that city to a point on this road in the spring.

Projects and Surveys.

Duluth, St. Cloud, Mankato & Southern.—Mr. N. B. EVARTS, of Webster City, Ia., Chief Engineer, gives us the following information:

The preliminary survey for this road has been completed. The road is to run from Duluth via St. Cloud, Litchfield, Gaylord, Mankato, St. Clair, Geneva, and Austin to Lyle, a distance of 325 miles. The work is light. We have a land grant of four sections to the mile for 190 miles. The road was incorporated in 1887. JOHN COOPER of St. Cloud is President.

Chicago, Freeport & Sioux City.—Articles of incorporation have been filed granting a charter to F. S. MOFFATT of Chicago, E. C. BRINK of Fremont, Neb., A. L. BRINK of Warren, Ill., and others for construction of a railway between Freeport and Galena, Ill., with branches to the Wisconsin and Illinois State lines. The principal offices will be at Chicago and the capital stock is $1,500,000.

Creston & Southeast.—This company has recently reorganized with a new board of directors, among whom are the following men: A. P. STEPHENS, C. S. REX, J. B. HARRIS, and W. M. GRANDS. The object of the company is to build a line of railway from Creston southeast to Van Wert, Ia., about 30 miles, intersecting the Diagonal and Keokuk & Western railways.

THE SOUTHWEST—Existing Roads.

Kansas City, Texarkana & Gulf.—Several months ago the city of Texarkana, Ark., agreed to turn over 8 miles of road already completed to this company, headed by J. F. HINCKLEY, which agreed to push work at once on an extension to Fort Smith, Ark., and build a bridge across the Red river. As little if any work has been done, the city has declared the contract void, and a new company has been formed to build the proposed line from Texarkana to Fort Smith. A company has been formed with J. FORSMAN, President, and E. HOGABOOM, of the Hot Springs National Bank, as Treasurer. Correspondence is desired with capitalists who may wish to undertake the building of the road.

Cleveland, St. Louis & Kansas City.—Stevens & Schaeffer, of St. Louis, have taken a contract to grade 30 miles of this road from Augusta, Mo., west. This makes 70 miles of road now under contract. The contractors for the piers of the Alton bridge are getting their plant on the ground ready for work, and the mattress work along the river front at St. Charles is in progress.

Atchison, Topeka & Santa Fé.—The Blossburg branch has been extended from Dillon to Blossburg, N. M., 5 miles.——The Girard branch has been extended from Pittsburg to Chicopee, Kan., 3 miles.——The publication of a preliminary report of the company's financial status has somewhat allayed the feeling of distrust among the stockholders, though regret is expressed that so much doubt is still left as to the prospects and the present status of the company. The total net profits above operating expenses and fixed charges for the 11 months ending Nov. 30 were $1,066,000. During this period, dividends to the amount of $2,625,000 were paid, leaving a deficiency of $1,559,000. The above statement is for the Atchison system proper. The auxiliary systems controlled by the Atchison show a deficiency for the same period of about $3,000,000. Of this amount they have made good from their own resources about $18,000,000, the remainder having been advanced by the Atchison, Topeka & Santa Fé Co.

Southern Pacific.—Ricker, Lee & Co., who have the 60 mile grading contract for the extension from Victoria to Beeville, Tex., will finish their work by Feb. 20. Tracklaying is to begin at once.

Houston, Central Arkansas & Northern.—The Louisiana Penitentiary will set 600 convicts at work on this road at once. It is expected to have the line open from Bastrop to Columbia, La., by June 1.

Ft. Worth & Rio Grande.—This company and the San Antonio & Aransas Pass are each striving to outstrip the other in building the proposed railway from Kerrville

to Granbury. The former company has filed a mortgage to the Central Trust Co. of New York to secure bonds to the amount of $20,000 per mile on the extension. The Aransas Pass managers have agreed to build from Kerrville to Llano if $150,000 local aid is raised. As all but $10,000 of this amount has been now subscribed, it is probable that work will begin very soon.

Texas, Sabine Valley & Northwestern.—This road is soon to be extended from Longview Jc., Tex., northwest to Harris via Gilmer, and work is also to begin soon on the extension south toward Sabine Pass. R. J. EVANS of Longview is General Manrger.

Missouri, Kansas & Texas.—Proctor & Elliot of Boonville, Mo., have been awarded the contract for all ties required by the company during the ensuing year.

Chicago, Rock Island & Pacific.—The engineer corps which has just completed a preliminary survey from Liberal, Kan., to El Paso, N. M., has begun work on a second line between the two points, to run via the Pecos valley.

Kansas City, Wyandotte & Northwestern.—At the annual meeting held at Kansas City, last week, the old officers were re-elected, and the directors then started on a tour over the road and a trip to Hastings and other points in Nebraska, to determine the desirability of an extension in that direction.

Projects and Surveys.

Mason & Red River.—A project is on foot to build a railway from Mason, Tex., to a point on the Red River. STANLEY M. JONES, of Albany, Tex. has made surveys for the road and a company will be chartered shortly.

Lammi Interstate.—A bill has been introduced in the House of Representatives granting a charter to the Lammi Interstate Railway Co. The word "Lammi" is formed of the initial letters of the words Louisiana, Arkansas, Mississippi, Missouri and Illinois, those being the States through which the road is projected to run. The proposed route of the main line is from New Orleans, La., to Burlington, Ia., following the Mississippi valley and crossing the river twice, at Natchez, Miss., and Grand Tower, Ill. Two branches are to be built to Kansas City and to Kit Carson, Col. The salaries of President and Vice President are not to exceed $5,000 per annum. The company is to transport free for 100 years all Indians and their descendants in consideration of the fact that its lines are to develop the Indian Territory. Passenger fares are not to exceed 1½ cts. per mile and a similar low maximum is fixed for freight. In consideration of these low rates the company asks that the Government loan it $30,000 per mile to be repaid *without* interest in equal installments during 50 years. JOHN COWDON of New Orleans, La., is the projector of this insane scheme, which is not deserving of serious consideration.

Red River, Sabine & Western.—A press report states that work has commenced on this road at Nacogdoches, La. The company guarantees to complete the road by September 1, 1889. T. T. LLOYD of Marshall, Tex., is President.

ROCKY MT. AND PAC.—Existing Roads.

Prescott & Arizona Central.—This company is marketing an issue of $438,000 first mortgage bonds in England.

Tucson Globe & Northern.—This Arizona company is floating a bond issue of $2,000,000 7 per cent. bonds in England. The funds obtained are to be used in completing the line from Tucson to Globe, 110 miles, with a branch to the Deer creek coal fields, 20 miles. On the main line 10 miles of track from Tucson north were laid in 1886, and 30 miles more are graded.

San Diego & Cuyamaca.—Some trouble has arisen over the right of way for this new road at San Diego, and President J. C. LONG has threatened to build the road via Los Angeles unless more liberal terms are offered by the San Diegans.

San Francisco & Northern Pacific.—The tracklayers have almost finished work on the Cloverdale & Ukiah extension, and it is expected that the extension will be open for traffic early in March. The landslide at the tunnel a few miles north of Cloverdale has greatly delayed the completion of work.

Oregon Ry. & Nav. Co.—A party in charge of W. T. WATSON has just completed the location of a line from Mullan, Idaho, to Missoula, Montana, which will be built as soon the Washington & Idaho extension to Mullan is completed. The line has one tunnel 6,800 ft. long and another only a few hundred feet in length.

Oregon Pacific.—All work on the extension of this road has stopped for the winter. Several of the contractors have been closely pressed financially and their plant and tools have been attached, but it is believed that the matter will be adjusted before time to resume work in the spring.

Northern Pacific.—Right of way is being secured for an entrance to Butte, Montana, and it is supposed that work will begin in the spring on the extension from Three Forks via Boulder to Butte, paralleling the Montana Central. The new route will save 25 miles over the present one via Garrison and the Montana Central.

Rocky Fork & Cooke City.—Contractors Green, Keefe & Co. have completed the tracklaying from Laurel, Montana, south across the Crow Indian Reservation. It was necessary to complete this portion of the line before March 4, at which time the grant of right of way across the reservation became void unless the road were finished. The line will be pushed to the coal mines as fast as possible and a heavy traffic is expected from the start as the coal company has agreed to furnish 1,500 to 2,000 tons of coal per day for shipment over the Northern Pacific.

Billings, Clark's Fork & Cooke City.—It is stated that work on this Montana road will be resumed as soon as springs opens. P. M. GALLAGHER, of Billings, Montana is interested.

Projects and Surveys.

Los Angeles & Eastern.—THOS. J. RASK, of Los Angeles, Chief Engineer, writes as follows:

The surveys for this road will begin in March or as soon as the rainy season is over. The road as projected is to run from Los Angeles northeast through Pasadena and Kramer a distance of 97 miles. Part of the route is through the Mojave Desert. The work is generally light. The maximum grade is 2¼ per cent. and the maximum curve is 8°. There will be two tunnels of 4,000 ft. and 2,000 ft. length respectively. Part of the right of way has been secured. It is expected that contracts will be let about June, 1889. The company was incorporated Dec. 3, 1888. T. J. CUDDY, of Los Angeles, is President.

Seattle & Southern.—The directors of this company held a meeting at Seattle, W. T., on Jan. 29, and elected THOS. EWING of San Francisco, President; L. S. J. HUNT, of Seattle, Vice President; M. S. BATES of Seattle, Secretary. A force of engineers under R. H. STRETCH, has begun the surveys and President EWING states that the funds for construction have been raised and contracts for construction will be let as soon as the first division is located. The project is believed to be in the interest of the Southern Pacific.

San Diego Eastern Ry. & Terminal Co.—This company has been organized to build the proposed Ocean Beach & Delma Ry. from Roseville to Ocean Beach, and agrees to build the road within 6 months. WM. GRAVES, of San Diego, is General Manager of construction.

Pacific Short Line.—A correspondent asks us for the address of the Chief Engineer or General Manager of this project. The Wyoming Improvement Company, which has charge of the enterprise here, with an office in the Equitable building, refuses to give any information regarding its plans or works. From other sources, however, we gain the following information: The so-called Pacific Short Line is a projected railway from Sioux City, Ia., to Salt Lake City, Utah. The division in Utah is incorporated as the Salt Lake Valley & Eastern; the division in Wyoming, as the Wyoming & Eastern; and the Nebraska division, as the Nebraska & Western. MILLARD R. JONES, of 187 Greenwich St., New York City, is President of the Nebraska & Western, and DONALD MCLEAN is General Manager of the enterprise, with present headquarters at Sioux City. F. A. HILL, of the firm of Wakefield & Hill, of Sioux City, has been in charge of surveys on the eastern division.

The company has certainly spent considerable money in making surveys along its proposed route, and we believe several corps of engineers are still in the field. The managers are trying to interest Sioux City capital to the extent of a half million dollars, and we judge with this as a starter will go ahead with construction until they have enough road built to give them a foundation for floating bonds. Whether they can raise funds in this manner sufficient to build a railway about 900 miles in length across the Rocky Mountains, remains to be seen.

FOREIGN.

Persia.—FRANK H. CLERGUE, of Bangor, Me., has petitioned the legislature of that State for a charter for a company to operate railways, electric lights, telegraph, telephone and steamboat lines in Persia. President ARTHUR SEWALL, of the Maine Central is said to be interested.

Chili.—The North & South American Construction Company have let sub-contracts for the lines which they are to build in Chili to James Ross, of Montreal and to McArthur Bros., of Chicago.——Engineers M. B. SMITH, E. T. M. MACDOUGAL, and GEO. H. WEBB sailed from Port Townsend, W. T., for Chili on January 30.

Costa Rica.—Stock and bonds to the amount of £3,055,000 are being floated in London for building this road. M. C. KEITH is the contractor and JAS. LIVESEY, Dashwood House, 9, New Broad St., London, E. C., is Chief Engineer.

RAPID TRANSIT.

Electric Railways.—***Bangor, Me.***—Hon. GEO. P. WESCOTT has presented a bill to the railway committee of the Legislature to amend the charter of the Presumpscot River Ry., which will probably be an electric line.

Troy, N. Y.—The Troy & Lansingburg Ry. Co. proposes to operate its line by electricity.

Atlantic City, N. J.—The street railway, which is owned by the Pennsylvania R. R. Co., is to be operated by electricity and a contract has been awarded to the Sprague Electric Co.

Negaunee, Mich.—An electric railway is to be built between Negaunee and Ishpeming, a distance of 3 miles. The plant will be driven by water power.

St. Louis, Mo.—The Newstead Avenue Electric Railway Co. will build a line 5¼ miles long. There will be one trestle 600 ft. long. GEO. W. COLE, EDWIN HAYDEN and J. T. DONOVAN are interested.

Salt Lake City, Utah.—The street railway company has decided to operate 5 miles of its line on some electric system, and hopes to have the same in operation by May. Ten of the old cars of the 23rd St. line, New York, have been purchased, and will be used for the equipment of the electric road.

Sacramento, Cal.—The Central Railway Co. has applied for franchises for electric roads on certain streets, and has made arrangements for the necessary capital. Contracts will be let as soon as the franchises are granted. L. L. LEWIS is President of the company.

The Woodward Electric Storage Car is being tried on the 3rd Ave. line in South Brooklyn, N. Y. W. H. TAYLOR, of 55 Broadway, New York, is the agent of the company.

Cable Railways.—***Chicago, Ill.***—The North Chicago Street Ry. Co. opened its Lincoln Ave. branch on Jan. 22. The line is 1½ miles long, and electric communication is established along the route, so that notice may be sent to headquarters in case of accident or breakdown. There are 2 steam engines built by Robert Wetherill & Co., of Chester, Pa., and 8 boilers.

Kansas City, Mo.—The Kansas City Cable Ry. Co. has commenced work on the extension of the Independence Ave. line.

Dummy Lines.—***Macon, Miss.***—A dummy line is to be built to some point on the Bigbee river. W. H. BOGLE is interested.

Denver, Col.—The County Commissioners have granted to DONALD FLETCHER the franchise for a motor line; one mile is to be in operation within 3 months.

Santa Clara, Cal.—The County Supervisors have granted to A. MALPAS, and others, a 49 years franchise for a dummy line between Santa Clara and Saratoga. The line will be laid on one side of the avenue, which is 100 ft. wide. There will be stations at intervals of 1 mile.

Street Railways.—***Troy, N. Y.***—A company has been organized to build a street from Troy to Eagle Mills, 1½ miles. The capital is $10,000; all of which has been subscribed. Other street railways are projected, including a belt line.

Washington, D. C.—The Anacostia & Potomac Ry. Co. will commence extensions in April. New rails will be laid on the existing lines.

Nashville, Tenn.—The Lischey Ave. & National Cemetery Ry. Co. (which is in the interest of the Main St. & Lischey Ave. Street Ry. Co.) will build a line 4¾ miles long from the city to the cemetery. The line will be through farming country and will have easy grades. Passenger traffic only. Most of the right of way has been obtained, surveys and estimates made, and $5,500 subscribed, but no work has been done in consequence of the action of the city authorities and the Edgefield Street Ry. Co. in relation to the terminal facilities of the main St. & Lischey Ave. line.

Duluth, Minn.—The Metropolitan Street Ry. Co. has been incorporated, with a capital stock of $500,000. President, C. E. DICKERMAN; Vice President, A. R. MACFARLANE; Secretary, WM. E. RICHARDSON; Treasurer, RONALD M. HUNTER.

CONTRACTING

Sewers.—***Fulton, N. Y.***—The following proposals were opened Jan. 25: M. Sullivan, Little Falls, N. Y., $20,240.05; James Duell, Brooklyn, N. Y., $20,627.85; John Marsden, Utica, N. Y., $23,622.24; O. J. Jennings, Fulton, N. Y., $23,912.51; J. J. Dwyer, Utica, N. Y., $24,962.10; P. J. Condon, Jersey City, N. J., $25,638.50; T. D. Lewis, Brooklyn, N. Y., $28,855.39; Troy Public Works Co., Troy, N. Y., $26,628.45; E. D. Broderick, Troy, N. Y., $26,714.55; Everson & Liddle, Yonkers, N. Y., $27,200.20; Stanton & Neary, Cohoes, N. Y., $27,687.20; Adam Miller, Saratoga, N. Y., $28,354.05; Wm. Patrick, Fulton, N. Y., $33,995.85; Austin & Caldwell, New Britain, Conn., $35,050.45. The prices of the lowest bid were as follows: 6, 8, 9 and 10-in. pipe laid, 21½, 18½, 15½ and 11 cts. per lin. ft.; Y's, 49, 41, 35 and 23 cts. extra; bends, 63, 51, 41 and 25 cts. extra; iron pipe, 81 cts. per ft.; manholes, $41; flush tanks, $77; lampholes, 13; railway crossing, 49 cts. per ft.; rubble masonry, $3 per cu. yd.; rock, $1.63 per cu. yd.; excavation and backfilling, from 15 cts. per ft. for 5 ft. deep to 89 cts. for 16 ft. deep. The work is as follows: 3,280 lin. ft. of 10-in. pipe, 1,115 ft. of 9-in., 3,850 ft. of 8-in., 20,500 ft. of 6-in., 1,484 Y's, 60 bends, 192 ft. of 10-in. iron pipe, 28 manholes, 35 flush tanks, 21 lampholes, 200 lin. ft. of railway crossing, 20 yds. stone masonry, 2,000 yds. rock, 38,830 lin. ft. of excavation and backfilling. The engineers are LANDRETH & FITZGERALD, of Schenectady, N. Y.

Street Work.—***Boston, Mass.***—The following proposals for curbstones have been received by the Park Commissioners: James J. Vernon, Lanesville, Mass., $1.57 per lin. ft.; Rockport Granite Co., Rockport, Mass., $1.50½; Cape Ann Granite Co., Cape Ann, Mass., $1.06; Albert A. Libby & Co., Boston, Mass., $1.67; Pigeon Hill Granite Co., Rockport, Mass., $2.47. The contract was awarded to James J. Vernon.

Brooklyn, N. Y.—Proposals for flagging sidewalks, received recently by the Commissioner of City Works, ranged from 21½ to 24 cts. per sq. ft.

Jersey City, N. J.—Proposals opened recently by the Board of Public Works ranged as follows: earth excavation, 19 to 37 cts. per cu. yd.; rock excavation, 1 ct. to $3 per cu. yd.; sand or gravel filling, 27 cts. to $1.50 per cu. yd.; paving, $1.27 to $2 per sq. yd.; curbstone, 47 to 60 cts. per lin. ft.; bridge stone, 40 to 60 cts. per sq. ft.

Baltimore, Md.—The following proposals were opened Jan. 28 by A. E. SMYRK, City Commissioner: Patrick Reddington, 10½ cts. per cu. yd. for grading; 30 cts. per lin. ft. for curbing, 6 cts. per sq. ft. for paving; James P. McGovern, 12 cts., 30½ cts., 5½ cts.; Bergman & Peddicord, 15 cts., 36 cts., 5¼ cts.; Michael O'Neil, 15½ cts.; 40 cts., 6 cts.; M. J. Flannery, 17 cts., 40 cts., 5¾ cts.; Pinning Bros., 18 cts., 40 cts., 5½ cts.; Patrick Keelly, 20 cts., 40 cts., 6 cts.; A. Schneider & Son, 35 cts., 45 cts., 7 cts. The contract was awarded to Patrick Reddington.

Terre Haute, Ind.—The following proposals for improving 15th St. have been received by GEO. H. SIMPSON, City Engineer: J. E. Vorhees, $1 per lin. ft.; John Daily, $1.04; P. McCabe, $1.12½; Braxton Cox, $1.18; Chas. Turrell, $1.85. The contract was awarded to J. E. Vorhees.

Helena, Mont.—The following proposals for grading have been received by the Street Committee: Milligan & Hughes, 40 cts. per cu. yd. for earth, 50 cts. for loose rock, and 90 cts. for solid rock; Emil Kluge, 35, 48 and 90 cts.; Green & DeWitt, 23 cts., 34 cts., $1.40; Chas. Kenton, 34, 63 and 95 cts.; R. H. Kleinschmidt, 28 cts., 92 cts., $1.70; Thos. Rice, 45 cts., 72 cts., $1.19; Wm. F. Bryant, 50 cts., $1.20, $1.20; Patrick Noonan, 40 cts., 60 cts., $1.50; T. B. Purcell, 40 cts., 65 cts., $1.15.

Los Angeles, Cal.—The Board of Public Works has awarded contracts for grading as follows: A. A. Heilchew $1.90 per. lin. ft.; Chase & French, $1.66 and $1.68; F. W. Barrow, $2.50; C. C. Adams, $4.48; D. F. Donegan, $1.60 and $2.60.

San Antonio, Tex.—The contract for street paving has been let to Walter Scott & T. H. Micklejohn, at $79,437. The paving will consist of 4 ins. of concrete, then a ½-in. bed of sand, and then a paving of hexagonal mesquite blocks, 5 ins. deep; the blocks are cut on a batter of ½-in. to 5 ins., so as to make space of 1-in. between the blocks. PAUL PRETZER is City Engineer.

Special Castings.—The following proposals for furnishing 150 tons of specials were opened Jan. 29 by the Board of Water Commissioners, Boston, Mass.: Mellert Foundry & Machine Co., Reading, Pa., $50.38 per gross ton; Warren Foundry & Machine Co., New York, $51.52; Gloucester Iron Works, Philadelphia, Pa., $55; McNeal Pipe & Foundry Co., Burlington, N. J., $55; R. D. Wood & Co., Philadelphia, Pa., $55.50; Builders' Iron Foundry, Providence, R. I., $57.50; Charles Miller & Son, $59.

Tunnel.—Mayor ROCHE, of Chicago, Ill., has directed the City Engineer to prepare plans for the improvement of the Washington St. tunnel. The work will cost from $110,000 to $120,000.

Railway Stations.—James H. Seaman, of Poughkeepsie, N. Y., has the contract for building the six stations between Highland and Campbell Hall, on the Hudson Connecting Railway. A uniform type of station building has been adopted, consisting of a waiting-room at one end and freight room at the other, with offices for the ticket agent and telegraph operator between. Where the business promises to be large, there will be two passenger rooms and a separate freight station. The stations will cost from $1,500 to $2,000 each, and they are to be built as rapidly as possible. Other stations are to be built on this road, and on the Poughkeepsie & Connecticut Ry.

Dams.—The following proposals for the construction of dams in the Ohio river were opened Jan. 30 by Lieut. Col. WM. E. MERRILL: Dam between Davis and Neville islands: Oliver Reed, Water Cure, Pa.—oak and hemlock timber, $26 and $18 per M. B. M.; drift bolts and spikes, 5 cts. per lb.; rip-rap stone, $1.25 per cu. yd.; paving, $3 per square; total, $6,761.25. I. V. Hoag, Jr., Pittsburg, Pa.—timber, $25 and $19; bolts and spikes, 3 cts.; rip-rap, $1.50; paving, $1.90; total, $7,111.45. A. W. McDonald, Coraopolis, Pa.—timber, $27.50 and $21.50; bolts, 4½cts.; spikes, 5 cts.; rip-rap, $1.65; paving, $3.75; total, $8,095.—Dam at head of Marietta island: Josiah T. Hart, Harmar, O.—timber, $23.50 and $25; bolts and spikes, 4 cts.; rip-rap, 80 cts.; paving, $1.50; total, $8,629.40. Joshua R. King, Belpre, O.—timber, $25 and $23; bolts and spikes' 4 cts.; rip-rap, $1; paving, $1.50; total, $9,154.70. W. A Snodgrass, Marietta, O.—timber, $25; bolts and spikes' 2¾ cts.; rip-rap, $1; paving, $2.70; total, $9,401.95. I. V' Hoag, Jr., Pittsburg, Pa.—timber, $25 and $19; bolts and spikes, 3 cts.; rip-rap, $1.50; paving, $1.90; total, $10,926.90. A. W. McDonald, Coraopolis, Pa.—timber, $26 and $21; bolts, 4½ cts.; spikes, 5 cts.; rip-rap, $1.42; paving $3.75; total, $11,510.

Dikes.—The following proposals for constructing dikes in the Ohio river were opened, Jan. 30, by Lieut. Col. WM. E. MERRILL, U. S. Engineer Office, Cincinnati, O.:—At Eight-mile island: John J. Shipman, Washington, D. C., oak and hemlock timber, $17 per M.; drift bolts, 4 cts. per lb.; spikes, 6 cts. per lb.; rip-rap stone, 78 cts. per cu. yd.; paving, $1.20 per square; total, $14,978. C. A. Clendinin, Gallipolis, O., $16,029; Fred Hartweg, Dayton, Ky., $16,190; John F. King, Belpre, O., $16,354.25; Graham & Gardener, Gallipolis, O., $16,666; Joshua R. King, Belpre, O., $17,432.50; James R. Ware, Cincinnati, O., $17,967.50; I. V. Hoag, Jr., Pittsburg, Pa., $21,390; J. T. Hart, Harmar, O., $22,357; Stender, Chaplin & Co., North Martinsville, W. Va., $63,257.50.

At Bonanza bar: John J. Shipman (prices same as above), $15,868.80; P. H. Kelly, Portsmouth, O., $18,351; F. Hartweg, $19,199; J. R. Ware, $19,443; W. H. Wheeler & Co., Sciotoville, O., $19,764; Graham & Gardner, $20,461; Richardson & Monroe, Portsmouth, O., $20,697.40; B. R. Morton, Newport, Ky., $22,088.40; J. R. King, $22,395; I. V. Hoag, $24,004.60; Wm. Strachan, Cincinnati, O., $29,386.

At Madison, Ind.: Wm. Kirk, Madison, Ind., piles, $2 each; brush, 85 cts. per cord; oak plank, $25 per M.; drift bolts, 3 cts. per lb.; rip-rap stone, 85 cts. per cu. yd., total, $12,595.50, H. C. Jones, Madison, Ind., $14,775.10; F. Hartweg, $17,617.32; J. R. Ware, $17,848.10; J. J. Shipman, $17,958.50; P. R. Kelley, $18,573.50; B. R. Mortou; $12,660.20; Richardson & Monroe, $22,871.50; I. V. Hoag, Jr., $23,037.

At Caseyville, Ky.; Wm. Kirk; piles, $2.50 each; brush, 90 cts. per cord; oak plank, $25 per M.; drift bolts, 3 cts. per lb.; rip-rap stone, $1 per cu. yd.; total, $25,453. Eizenmann & Hollerbach, Rockport, Ind., $25,789; Jacob Arnold & Co., Evansville, Ind., $25,943; F. Hartweg, $27,734; J. J. Shipman, $31,421; J. R. Ware, $33,331.20; H. S. Hopkins & Co. and Peter McGee, St. Louis, Mo., $33,481.40; J. V. Hoag, Jr., $35,317; Richardson & Monroe, $35,866.30; McGown & Kluge, Golconda, Ill., $36,015.10; Goulding & Appleby, New Albany, Ind., $60,146.

The prices given are those of the lowest bids; the highest prices were as follows: timber, $40 per M.; drift bolts, 16 cts. per lb.; spikes, 6 cts. per lb; rip-rap stone, $4.50 per cu. yd.; paving $6.00 per cu. yd.; poles, $5 each; brush $3.40 per cord; plank, $42 per M. Each bidder's address is only given once, to save space.

Government Work.—The following proposals for repairs and renewals at Fort Carroll, Md., were opened Jan. 31, by Col. WM. P. CRAIGHILL, U. S. Engineer Office, Baltimore, Md.: S. P. DeMuth & Co., Long Green, Md., $1,493.50; Hy. Fox, Baltimore, $1,530; Chas. Ogle, Baltimore, $2,358; Spicknall Bros., Baltimore, $2,380.32; Geo. H. Morrow, Baltimore, $2,425; A. W. Baltziey, Baltimore, $2,550; J. H. McIntyre & Co., Washington, D. C., $2,870; C. J. Fox, Baltimore, $3,300; D. E. Clark, Baltimore, $3,450; H. C. Smyser, Baltimore, $3,485.

Timber Dry Dock.—The only proposal for the construction of the timber dry dock at the League Island navy-yard, received February 1, by D. B. HARMONY, U. S. N., Chief of the Bureau of Yards and Docks, Washington, D. C., was from J. E. Simpson & Co., 35 Broadway, New York. The price was $548,700 for a dock 500 ft. long, and $975 per lin. ft. for any length over 500 ft.

Dredging.—The contract for dredging the Peconic river, Long Island, N. Y., has been awarded by JAMES SHANAHAN, Superintendent of Public Works, to John Van Patten & Co., of West Troy, N. Y.

Wharf.—The contract for completing the Government wharf at Charleston, S. C., has been awarded to the Southern Construction Co. of Nashville, Tenn., at $132,800.

PROPOSALS OPEN.

Street Work.—Granite curbing, flagstones, cobblestones, gutter stones, Belgian blocks, iron gutter plates; for the current year. A. E. SMYRK, City Commissioner, Baltimore, Md. February 11.

Sewer and Gravel.—About 3,080 lin. ft. of brick sewer and 200 ft. of 12, 15 and 18-in. pipe sewer, manholes, piling, etc.; also 6,000 cu. yds. of screened Roa Hook gravel. THE PARKS COMMISSIONERS, 49 and 51 Chambers St., New York. February 13.

Street Work.—Flagging sidewalks, grading and cobblestone paving. JOHN P. ADAMS, Commissioner of City Works, Brooklyn, N. Y. February 14.

Pipe, Hydrants and Sewer.—Furnishing and laying water mains, stop cocks, hydrants, boxes, etc. Also sewer. THE COMMISSIONER OF PUBLIC WORKS, 31 Chambers St., New York. February 19.

Dredging.—About 27,000 cu. yds. at Pier 57 (new) North river. THE DOCKS COMMISSIONERS, Pier A, North river, New York. February 19.

Water-Works.—Rental plan, or works to be purchased by the city. Plans and specifications on file. A. L. HOWE, Chairman Committee on Gas and Water, Natchez, Miss. February 21.

Electric Lighting.—For new U. S. building at Baltimore, Md. C. S. FAIRCHILD, Secretary of the Treasury, Washington, D. C. February 25.

Irrigation Bonds.—Redemption of bonds for $10,000. M. D. JOHNSON, City Treasurer, Los Angeles, Cal. February 25.

Bridge.—Across the James river at Eagle Rock. F. A. COOPER, Chief Engineer, Craig Mineral Ry., Eagle Rock, Va. March 1.

County Building.—Court house and jail. Architect, F. C. EBERLEY, Denver. JOSEPH H. SMITH, County Clerk, Denver, Col. March 13.

Bridge.—Across Big river, 250 ft. span. THE COUNTY SUPERVISORS, Mendocino, Cal. April 5.

GOVERNMENT WORK.

Pipe, Pump, etc.—Steam pump; steel, horizontal, tubular boiler; 2,700 ft. cast-iron pipe. Major JOHN A. KRESS, U. S. A., Benicia, Cal. February 14.

Submarine Torpedo Boat.—Time extended. WM. C. WHITNEY, Secretary of the Navy, Washington, D. C. February 15.

Dikes and Mattresses.—In the Rappahannock river. S. T. ABERT, U. S. Engineer Office, Washington, D. C. March 1.

Sea Wall.—On Governor's Island, N. Y. H. Lieut-Col D. C. HOUSTON, U. S. Engineer Office, New York City. March 11.

Marine Engines.—For U. S. armored cruiser *Maine*. Time extended. WM. C. WHITNEY, Secretary of the Navy, Washington, D. C. March 15.

MANUFACTURING & TECHNICAL.

Basic Steel.—A company is to be organized to experiment on the manufacture of basic steel near Birmingham, Ala.

Marine Engines.—Proposals will be received by the Secretary of the Navy until April 3 for the engines, boilers, screws, shafting, pumps, etc., for the United States armored battle ship *Texas*.

Fuel Gas.—The Addyston Pipe & Steel Co. has started the new Loomis fuel gas plant at its works at Addyston, O. The plant comprises four large generators, with the corresponding equipment, and furnishes both water gas and generator gas. The latter is used under boilers, etc., while the former is used in the drying shops, forges, etc. The shops will also be lighted by the gas, and the town will be supplied with gas from the works.

Steel Works, Rolling Mills, etc.—The Troy Steel & Iron Co. of Troy, N. Y., is now making foundry iron instead of Bessemer steel, on account of the scarcity of orders for rails.

The Passaic Rolling Mill Co. of Paterson, N. J., will add two 20-ton open-hearth steel furnaces to its plant, at a cost of $100,000.

Carnegie Bros. & Co. will build a large foundry near the present works at Braddock, Pa.

The Allegheny Bessemer Steel Co.'s works at Duquesne, Pa., are completed. There are two 7-ton converters. Natural gas will be used for fuel. Steam is supplied by 20 boilers for the rail mill, and 16 boilers for the converting plant.

A steel plate-mill is to be erected at Coatesville, Pa., by Chas. Houston & Sons. The rolls are being made by the Garrison Foundry Co., and the trains by McIntosh, Hemphill & Co., both of Pittsburg.

The Rome Rolling Mill Co. has been organized at Rome, Ga., by WM. F. NEVEGOLD and others. Capital stock, $40,000.

A large foundry and machine shop is to be built at Pueblo, Col., by parties from Des Moines, Ia.

Car Lighting and Heating.—The Philadelphia & Reading will equip a number of passenger cars with the Frost dry carburetter system of lighting.

The Southern Pacific is fitting up some of its trains for steam heating from the locomotive. Electric lighting is also to be tried.

The Martin system of car heating is now being tried on the Terre Haute and Logansport division of the St Louis, Vandalia & Terre Haute.

The Timlin-Heidinger system of car-heating is being tried on the Rome, Watertown & Ogdensburg.

Graphite.—The Joseph Dixon Crucible Co. of Jersey City, N. J., manufacturers of crucibles, graphite paints, pencils and lubricants, states that the past year was notable for the large increase in the business of such specialties as silica graphite paint, graphite pipe joint grease, graphite grease, etc. The works have been enlarged and a continued good business is expected.

Splice Bars.—The Samson splice bar manufactured by Morris Sellers & Co. of Chicago is to be made of steel as well as iron, and a new rolling mill has been put in for this work.

Signals.—The Baltimore & Ohio is equipping some of its junctions with a system of switches and semaphore signals operated from a central switch tower.

Lake Superior Iron Ore.—The returns of rail shipments of iron-ore from the Lake Superior iron mines direct to furnaces for the year 1888 bring the production of the lake iron mines for that year up to 5,023,329 gross tons. This is the largest production ever achieved by the iron mines of the Lake Superior region in a single year, and is 284,426 tons in excess of the output in 1887. The shipments from the several ranges by lake and rail were as follows: Marquette, 1,921,575 tons; Menominee, 1,165,009 tons; Gogebic, 1,424,762 tons; Vermillion, 511,953 tons.

Car Replacer.—The Dunham Mfg. Co. of Boston reports a number of orders for the Keystone car replacer.

Catalogue.—The Wm. A. Harris Steam Engine Co. of Providence, R. I., issues an illustrated catalogue descriptive of the Harris-Corliss engine, with description, list of standard sizes and details of trials made.

Rail Joint.—The Van Wie Rail Joint Co. of Troy, N. Y., has elected the following directors: Capt. R. W.

HUNT, WALDO K. CHASE, E. S. MURRAY, GILBERT GEER, Jr., C. D. HAMMOND, EDWIN VEGHTE, and BYRON VAN WIE.

Sewer Pipe Works.—The California Sewer Pipe Co. has commenced operating its new works at Los Angeles, Cal. They have a daily capacity of 4,000 ft. of 6-in. or 3,000 ft. of 8-in pipe. The works cost $128,000, and the company has already an order on hand for $60,000 worth of pipe for Fresno, Cal. Pressed brick will also be manufactured.

The Portland Cement Pipe & Stoneware Co., of Portland, Me., will build a 3-story office building as the business has outgrown the present quarters.

Locomotives.—The Schenectady Locomotive Works of Schenectady, N. Y., have turned out 2 freight engines for the Connecticut River road.

The Rogers Locomotive Works of Paterson, N. J., are building 18 engines for the Eastern Minnesota—18 by 24-in. cylinders, 63-in. drivers.

The East Tennessee, Virginia & Georgia has received 4 large moguls for the Georgia division.

The Mexican National will soon order 15 new locomotives. Address JOHN F. O'BRIEN, General Manager, Laredo, Tex.

The Lake Shore & Michigan Southern is having specifications for some heavy passenger and freight engines prepared by the Superintendent of Motive Power. Contracts will be let shortly.

The Taunton Locomotive Mfg. Co. of Taunton, Mass., has orders on hand for 11 engines including some narrow-gauge Forney engines for the Boston, Revere Beach & Lynn.

The Cooke Locomotive Works of Paterson, N. J., are building extensive additions to the shops.

Car Notes.—The Elliott Car Co. of Gadsden, Ala., has completed an order for 100 furniture cars, and is now at work on 17 cabooses, 35 fruit cars, and 250 flat cars for the Alabama Great Southern. Some car trucks have also been built for the Anniston & Atlantic.

The U. S. Rolling Stock Co. has completed 10 box cars for the Anniston & Cincinnati.

The Peninsular Car Co. of Detroit, Mich., is building 50 refrigerator cars for the Northern Pacific.

The Lafayette Car Works of Lafayette, Ind., have built 200 cars for the Cincinnati, Indianapolis, St. Louis & Chicago.

The Jeffersonville Car Co. of Jeffersonville, Ky., has a contract for 10 cars for a suburban road at Memphis, Tenn.

The Georgia Central Ry. Co. has been receiving bids for 1,000 ventilated freight cars, and it is reported that a larger number will be ordered.

The Leamington & St. Clair Ry. Co. will order some new rolling stock. C. F. HANSON of Leamington, Ont., is Superintendent.

The Mexican National Ry. Co. will order 500 freight cars. Address JOHN F. O'BRIEN, General Manager, Laredo, Tex.

The Wagner Palace Car Co. is building at its works at Buffalo, N. Y., four vestibuled cars for the New York & Chicago limited express over the New York Central and the Lake Shore roads. The aisle is along one side of the car, and the sections form staterooms across the car.

The Cleveland, Columbus, Cincinnati & Indianapolis is building 84 flat cars at its shops at Cleveland, O.

Street Railway Cars.—The St. Louis Car Co. of St. Louis, Mo., has recently secured contracts for building 15 summer cars for the Union Depot line of that city, and 20 cars for the Evansville Railway Co., Evansville, Ind. The company has shipped 8 cable cars to Seattle, W. T. It has ready to ship 10 cable cars for the Union Railway Co. of Kansas City. These cars are equipped with the Terry grip, which was tested in St. Louis a few years ago.

Ties.—The Northern Pacific is asking for bids for furnishing about 75,000 cross ties on the Pacific division, and 200,000 ties on the Idaho division. These ties are all to be hewn, and are to be 8½ by 9 ins. by 8 ft. long. They are to be of red fir or tamarack. The average life of fir and tamarack ties has not been determined exactly, but it is in the neighborhood of 5 years.

BRIDGES AND CANALS.

Bridge Notes.—***Willimansett, Mass.***—It is proposed to build a bridge between Willimansett and Holyoke, and a committee has been appointed to prepare a petition to the Legislature. President, J. B. STRATTON; Secretary, P. J. NEWELL.

Niagara Falls, N. Y.—The contract for the steel work of the new suspension bridge, to replace the one recently blown down, has been awarded to the Rochester Bridge & Iron Works, of Rochester, N. Y. Construction will be commenced in April. GEO. MCNULTY is the engineer and M. HARRINGTON is Superintendent.

Sea Isle, N. J.—The Pennsylvania R. R. Co. is replacing the Townsend inlet bridge, which was washed away a few weeks ago.

Verona, Pa.—The Verona Bridge Co. has been organized by HENRY BEBO, G. H. MOORE, and W. A. THOMPSON of Verona; H. S. PAUL of Pittsburg, and Dr. B. F. MCINTOSH of Sharpsburg. Capital stock, $100,000. The company will build a bridge across the Allegheny river.

Parkersburg, W. Va.—The Secretary of War has detailed Major D. W. LOCKWOOD, U. S. Engineer, to examine the location of the proposed bridge over the Little Kanawha, and to confer with the bridge authorities in regard to the construction of a draw in the bridge.

Spottsville, Ky.—The Louisville, St. Louis & Texas Ry. Co. has come to a settlement with the Keystone Bridge Co. and a new draw span is to be built at once to replace the one recently wrecked in the attempt to prevent the railway company from using it.

Pineville, Ky.—The four masonry piers for the Cumberland River bridge of the Louisville & Nashville, about 1 mile above the town, have been completed. GEO. TRESHER of Lewisburg, Pa., was the contractor.

Frankfort, Ky.—The old wooden bridge which the Secretary of War has ordered to be raised, it being too low for navigation, was built under a charter granted in 1811. It will probably be replaced by a new iron structure.

Atalla, Ala.—The County Commissioners will build an iron bridge near here.

Montgomery, Ala.—A local company will apply to the next Legislature for a charter for a bridge across the Alabama river to Maplesville. It will be a railway and highway bridge.

Ashtabula, O.—The County Commissioners will build a bridge over the river, with a channel span of 100 ft.

St. Paul, Minn.—The construction of the Broadway bridge to West St. Paul is not yet assured, not enough money having been provided for a high-level bridge, the cost of which is estimated at $300,000, and the War Department will not permit another low-level bridge.

La Crosse, Wis.—The Senate at Washington, D. C., has reported favorably upon the projected Mississippi river bridge.

Loutre Creek, Mo.—The contract for a highway bridge over the creek (in Montgomery Co.) has been awarded to the St. Louis Bridge & Iron Co.

The Nashville & Knoxville Ry. Co. will build bridges across the Cumberland and Caney Fork rivers.

The St. Louis & San Francisco Ry. Co. has awarded several bridge contracts to the Chicago Forge & Bolt Co.

Ohio Canals.—The State Canal Commissioners have made their first annual report. It states that the survey of the Miami & Erie canal has been made from Toledo to Sidney, and that the sale of the Paulding County reservoir realized $16,284.50 to the State, leaving 137½ acres, besides 5,300 lin. ft. of the canal-bed, unsold. They recommend the sale of 10 miles remaining of the Wabash & Erie canal, and also the reclaiming of about 400 acres of land in the Mercer County reservoir, which could be done at a cost of about $30,000, and the reclaimed lands would be worth $40,000. The Commission recommends that the future policy of the State should be to extend the canals from Lake Erie to the Ohio river. They should be put in condition for boating and maintained in that condition. Other canals and feeders that yield no revenue and are an annual charge upon the Treasury might, perhaps, be sold where this would not prove detrimental to local interests.

The Chicago River Canal & Dock Co. has been incorporated by A. COWLES, Jr., J. C. MASON, and F. W. NELSON. Capital stock, $2,000,000. The company proposes to construct and operate a canal between Lake Michigan and the north branch of the Chicago river.

Harbor.—The city of Montreal, Canada, has undertaken a scheme for the improvement of the harbor at a cost of $4,000,000. It will give 4 miles of wharfage and a still-water basin of 6 sq. miles. A pier is to be built in the middle of the river extending to the Victoria bridge, and will be used to form a basin and for handling heavy freight, as well as to protect the shore wharves from the encroachment of the ice. The street running along the river front is to be widened from 35 to 100 ft. and the wharves are to be raised to the same level. Steamers will then have their decks level with the wharf, instead, as at present, of their cargoes having to be raised from the hold and then lowered to the landing. A permanent stone dike will be erected to prevent floods, and it will be pierced with drainways, which will be guarded by immense iron gates. There will be ample space outside for lines of railways which will connect with the Grand Trunk and Canadian Pacific systems. The scheme has the support of eminent engineers, and in conjunction with the recent deepening of the channel from Montreal to the Gulf of St. Lawrence to a uniform depth of 27 ft., it will be a great stimulus to navigation.

ELECTRICAL.

Lockport, N. Y.—Two propositions for electric lighting have been received by the City Council. The Lockport Gas Light Co., which is at present lighting the city at $17,000 per year, offers (1) to furnish arc lights of 2,000 c.p. every night, except when the moon is full, at $80 each; (2) the same at $85 each, every night in the year; (3) 37 to 40 till 7 o'clock every night, and after that hour in accordance with the existing moonlight schedule; (4) about 176 Edison municipal incandescent lights of 20 c. p. same as now in use, moonlight schedule, at $14 each; (5) about 426 gas-lights with 5 ft. burners, moonlight schedule, $18, including lighting and extinguishing. The Citizens Electric Light Co., a new organization, of which Mr. VAN ZANDT is President, proposes (1) to furnish 120 arc lights of 1,000 c. p., to burn all night except when the moon is deemed "amply sufficient for the purpose of street lighting," at $7,500; (2) the same, if all-night lighting is not necessary, at $6,300. This latter bid is about the sum for which Mayor OLIVER guaranteed to do it with a plant owned by the city.

Electrical Companies.—The Bogota Electric Light Co., incorporated at Albany, N. Y., by A. LANGENBACH, FRANCIS BETANCOURT, and RAFAEL FIDEARI of New York, to maintain a plant in Bogota, U. S. Colombia. Capital stock, $100,000.

The Savannah Electrical Co. has been organized at Savannah, Ga., by HERMAN MYERS, C. F. PRENDERGAST, and P. W. MELDRIM, to operate telegraph and telephone lines. Capital stock, $50,000.

The Lakeside Electric Light, Power & Heat Co. has been organized at Chicago, Ill., by D. BARCLAY, E. S. CRAIG and CHAS. EAST. Capital stock, $10,000.

The Columbia Electric Light, Power & Heat Co. has been organized at Chicago, Ill., by J. J. MCEVOY, D. BARCLAY, and M. P. GERRITY. Capital stock, $15,000.

The Wright Electrical Engineering Co. has been organized at Boston, Mass. ALEX. P. WRIGHT is President.

The Electrical Engineering & Construction Co. has been organized at Chicago, by M. L. WILLARD, W. M. BRINKMAN, and A. A. BLISS, to manufacture and operate plants for electric light, heat, and power. Capital stock, $600,000.

Electric Light.—***Dedham, Mass.***—The Dedham Water Co. and the Dedham & Hyde Park Gas Co. both want to put in an electric light plant for the city.

Warren, R. I.—It is proposed to establish an electric light plant.

West Troy, N. Y.—The Thomson-Houston Co. has a contract to supply the village with 22 arc and 5 incandescent lights at $1,775 per annum.

Green Island, N. Y.—The Thomson-Houston Co. has made a proposition to put in 25 lights of 1,200 c.p. at $75 per light per year.

Brooklyn, N. Y.—Contracts for electric lighting have been renewed with the Citizens and Municipal companies at 50 cts. per light per night, or $182.50 per year, for lights of 1,200 c. p.

Beverly, N. J.—The Beverly Electric Light Co. has been organized. President, A. G. MCELROY; Secretary, H. C. VAN METER.

Philadelphia, Pa.—Councils' Electrical Committee has reported favorably the bill authorizing the Frankford Electric Light Co. to lay conduits in the 32st.-Ward. The company agrees to give the city two all-night lights free of charge, and to pay into the City Treasury 5 per cent. of all profits exceeding 6 per cent.

Wytheville, Va.—An electric light system is projected. Address CHAS. W. GLEAVES.

Huntington, W. Va.—The contract for supplying 50 electric street lights has been awarded to J. L. Cadwell for $3,600 and $50 for each additional light.

Nashville, Tenn.—The following proposals for electric lighting for 3 years have been received by the Board of Public Works and Affairs: Thomson-Houston Co., 28½ cts. per light per night; Nashville Light & Power Co., 40 cts.; Jenney Electric Light Co., of Indianapolis, 47 cts. The contract was awarded to the Thomson-Houston Co.

Mt. Sterling, Ky.—A company is to be organized to put in a Thomson-Houston plant.

Laurens, S. C.—An electric light plant is projected; the Edison system will probably be used.

Baton Rouge, La.—The Baton Rouge Electric Light Co. has been organized. President, B. R. MEYER; Secretary, JOSEPH GOTTLIEB.

South Chicago, Ill.—The Calumet Gas Co. will put in an electric light system.

Clinton, Wis.—The city has contracted with a Chicago company for 125 incandescent lights.

Helena, Mont.—The contract for electric lighting has been awarded to the Helena Steam Power & Lighting Co.

WATER AND MUNICIPAL.

Pineville, Ky.—In order to supply water to the city as soon as possible, the Pineville Water Co. decided not to wait for the completion of the reservoir on Laurel mountain, but to tap Bird's branch, on the mountain, at an elevation of 130 ft. above the court-house square, while the elevation of the reservoir will be 350 ft. A temporary supply basin has been constructed on the branch, about 2¼ miles from the city, and the supply pipe has been laid. Nichols & Davison, the contractors for pipe laying, have put down 14,000 ft. of supply pipe, 4,000 ft. of 4-in. distributing mains, 1,500 ft. of 6-in., and 2,500 ft. of 8-in.; 13 hydrants and several valves have been set. Connections will now be made and the company will supply water for domestic purposes and fire protection. Street improvements and sewer extensions are also in progress. R. MAHLO is City Engineer.

Fresno, Cal.—The following proposals have been received by the City Clerk: For furnishing a continuous flow of 2 cu. ft. of water per second, for 5 years, for flushing purposes, Alexander McBean, of Oakland, Cal., bid $5,500 per annum; M. Macdonald bid $5,000. For dis-

posing of the sewage for a term of 5 years, Alexander McBean bid $6,500 per annum, and M. Macdonald bid $26,-896 for the whole term. All the bids were rejected, as noted last week.

Drainage in Indiana.—The work of cutting a drain 20 ft. wide, 10 ft. deep and 11 miles long, to drain the swamp between Fort Wayne and Huntington is practically ended, after having been in progress for nearly 3 years. The swamp is separated from the Little Wabash river by a ledge of limestone nearly 2 miles wide, which held the water on the swamp to a depth of about 6 ft. The cost of cutting through this ledge was very great.——The Dayton Dredge Co. has the contract for digging a ditch about 14 miles long to drain the Loblolly swamp. The contract price is $18,000.

Water Bonds.—The following proposals for the $100,-000 of 4 per cent. water bonds have been received by the Finance Committee of Council, Allegheny, Pa.: Robinson Bros., $10,000 at 102⅛; Dollar Savings Bank, $100,000 at 104½; George Plummer, West Newton, $2,000 at 102½; Townsend, Wheelen & Co., $100,000 at 103½; R. S. Smith, Union National Bank, $100,000 at 105 15-100; W. I. Quintard, New York, $100,000 at 107 5-100. The bonds were awarded to W. I. Quintard.——The bonds mentioned last week were those awarded at Portland, Ore.

Sacramento, Cal.—Mr. W. R. COATES, of Michigan, has made a proposition to the city to furnish a supply of water from artesian wells, and explained his plans recently at a special meeting of the Board of City Trustees. The present supply from the river is fairly satisfactory, but the water is muddy and a much better quality of water would be furnished by the artesian wells. Mr. COATES has offered to make a test and an investigation of the whole matter.

Natchez, Miss.— Proposals are being advertised for the construction of water-works and the following particulars are taken from the specifications adopted by the city. The pipe is to be of cast-iron, 6 to 14 ins. diameter, and is to be coated with Dr. ANGUS SMITH'S preservative varnish. The hydrants are to have double nozzles, and 25 of them will also have a 4½-in. suction nozzle coupling. The pumping plant will consist of 2 high-service vertical engines with a daily capacity of 2,000,000 galls. each, and there is to be an approved system of filtering, with low pressure pumps for the same. The stand-pipe is to be 150 ft. high by 22 ft. diameter. The supply is to be taken from the Mississippi river, and the city is to be entitled to use water from the hydrants for fire purposes and for flushing sewers and gutters. The test is to consist in throwing 6 fire streams through 2½-in. hose to a height of 100 ft. The contractor is to build and operate the works, and the city is to have the right of purchasing them at the end of 10 years. Proposals will be received until February 21 for the construction of a complete system of works, upon two plans: 1st, on the rental plan, the contractor building and owning the works, and the city renting not less than 80 hydrants for fire purposes; 2d, for the erection of works to be purchased by the city. Plans and specifications are now on file. A. L. HOWE is Chairman of the Water & Gas Committee.

Fishkill, N. Y.—A masonry dam is to be built on North Beacon mountain, near Fishkill, to form a reservoir for an additional supply to the Fishkill and Matteawan water-works. The dam will be at an elevation of 1,200 ft. above the Hudson river, and will contain about 1,600 cu. yds. of stone masonry laid in Portland cement mortar. The contract has been awarded to HENRY H. HOLMES, of Jersey City, N. J.

Birmingham, Ala.— The Cahaba extension of the Birmingham water-works is being constructed, and the company expects to have the water turned on by January 1890. The pumping station is on the Cahaba river, and the water is forced through 14,000 ft. of 30-in. pipe to a reservoir of 100,000,000 galls. capacity, on Shade mountain at an elevation of 400 ft. From the reservoir to Red mountain, a distance of 17,200 ft. which includes a tunnel 7 ft. by 8 ft., 2,100 ft. long, the water mains are 20 ins. in diameter, and from that point to the city, where connection is made with the present system, the distance is 9,000 ft. There is also a tunnel through Sand Ridge 154 ft. long, 7 ft. by 8 ft. The pump is a Worthington high duty engine.

Sewerage.—*Brooklyn, N. Y.*—The City Council has authorized the issue of bonds for $120,000 for a relief sewer in Bond St.

Amsterdam, N. Y.—The Sewer Commission has issued $200,000 in bonds, and it is expebted to issue $15,000 more to complete the system.

Chattanooga, Tenn.—The city will issue $200,000 in sewerage bonds.

Palatka, Fla.—A sewerage system is projected. For particulars address the mayor.

Jacksonville, Fla.—The Board of Public Works has authorized the City Engineer to have an expert make a thorough examination of the sewerage system of the city, with a view to having it improved if necessary.

Birmingham, Ala.—The sewer system is to be extended about 2 miles, at a cost of $7,000 per mile. For particulars address the City Engineer.

Anniston, Ala.—Plans and specifications have been repared for a complete system of sewers.

Decatur, Ala.—The city proposes to issue bonds to pay for a sewerage system.

Ensley, Ala.—The Ensley City Land Co. has decided to put in sewers on the Waring system.

Natchez, Miss.—A proposition to build a sewerage system has been made by J. A. JONES, of St. Louis, Mo.

Mankato, Minn.—The contract for building the 2d St. sewer has been awarded to John Shaw, of Kansas City, for $16,116; this was the lowest of 12 bids, the highest being $28,000.

Winona, Minn.—A sewerage system is projected. Plans and specifications are to be prepared at a cost of about $1,500, and Mr. WILLIAMS, a Chicago engineer, estimates the cost of construction at $8,000 per mile.

Kansas City, Kan.—An extensive sewerage system, divided into 5 districts, is projected. Plans and specifications have been prepared by Mr. KIERSTED, C. E., and submitted to the city engineer.

Wichita, Kan.—The city has under contract about 64 miles of sewers, including main outlets, mains, sub-mains and laterals.

Portland, Ore.—The city council proposes to build a brick outlet sewer to carry off the waters of Johnson creek. It will be 8,500 ft. long, and about 3 ft. by 4 ft. in section.

Walla Walla, Wash. Ty.—Col. GEO. E. WARING will make an investigation of the projected sewerage system.

Los Angeles, Cal.—The city is reported to have rejected the West system of sewerage and sewage disposal and to be considering propositions to carry the outlet sewer to ranches at some distance, using open ditches after the sewer has reached about 3 miles from the city.

Corsicana, Tex.—The City Council has appointed a committee to consider plans for a sewerage system. For particulars address the mayor.

Water-Works.—*Massachusetts.*—Brockton. The City Council has passed an order authorizing the issue of water bond for $100,000.——Athol. The verdict in the case of SOLON L. WILEY vs. the inhabitants of Athol is for the full amount claimed, $5,000, and the interest amounting to $459. The trial has been in progress since Jan. 16. It was an action of contract to recover for the use of hydrants for fire purposes, the plaintiff being the owner of the water-works. The defence was that they were not liable in consequence of the non-fulfilment of the contract.

Connecticut.—Manchester. WM. FOULDS and others and CHENEY BROS. have applied for franchises for water-works. Both applications will be favorably reported upon by the water-supply committee.

New York.—Schenevus. The water-works have been inspected by a representative of the State Board of underwriters.——Albany. The Water Commissioners have decided to proceed as fast as possible with the work in connection with the new supply system.——Long Island City. The employés of the Water Department recently threatened to strike and cut off the water supply unless they were paid their salaries for December last. A special meeting of the Commissioners was held and payment ordered.

New Jersey.—Sea Isle. The Consumers' Water & Sewerage Co. will soon commence laying pipes from Magnolia lake, 2 miles distant. The water-works will be in operation by June.

Pennsylvania.—Chester. The case of the Holly Mfg. Co. against the Chester Water Pipe Co., asking for an order to compel the latter to relinquish possession of the pumping engines, has been compromised. The suit arose over the recent failure of S. R. Bullock & Co., who had contracted to build the works.

Virginia.—Abingdon. Water-works are projected. For particulars address the mayor.——Clifton Forge. The reservoir, with a capacity of 100,000 galls., is being built by W. C. Moody.——Wytheville. The Wytheville Water Co. will double the capacity of its reservoir, and the new works mentioned last week will probably not be built.——Lynchburg. The Lynchburg Land Co. proposes to build water-works to supply the western suburbs of the city.

South Carolina.—Spartanburg. The pumping engines for the water-works are being put in place.——Columbia. The Water-Works Commissioners will lay a line of 12-in. pipe from the new reservoir to the receiving reservoir, 3,800 ft.

Georgia.— Cedartown. The Empire Water, Light & Mfg. Co. has been incorporated by CHAS. P. BALL, J. H. MEED, and others, to build water-works, gas-works, etc. Capital stock, $100,000. The works will cost $60,000.—— Milledgeville. Water-works are projected.

Florida.—Tallahassee. A vote will be taken February 23 on the proposition to issue bonds to build water-works.—— Eustis. It is proposed to issue bonds to build water-works. Address GEO. W. CHURCH.

Tennessee.—Goodson. The City Council has secured the right of way for water-pipes from Moore's spring to the corporate limits. Pipe laying will be commenced in the spring.——Nashville. The city proposes to issue $300,000 of additional water bonds.——Tullahoma. Water-works are projected. For particulars address the mayor. ——Chattanooga. The City Water Co. has awarded the contract for the new reservoir of 20,000,000 galls. capacity to S. W. Duncan & Bros.

Kentucky.—Georgetown. Propositions for the construction of water-works will be received by S. DAVIS, Chairman of the Board of Trustees.——Harrodsburg. Water-works are to be built. Mr. SCOWDEN, City Engineer of Louisville, is interested.—— Pineville. F. A. HULL, of Danbury, Conn., is the engineer of the works now under construction.

Illinois.—Rogers Park. The Rogers Park Water Co. has been organized, with a capital stock of $50,000. President, H. E. KEELER. There will be 5¼ miles of 6 to 12-in pipe, 60 double-nozzle hydrants, pumping plant of 2,500,-000 galls. daily capacity, and stand-pipe 12 ft. by 100 ft. Two of the American Filter Co.'s filters will be used. Contracts will be let soon and the works will be in operation by July. CHESTER B. DAVIS, of Chicago, is the consulting engineer.——Camp Sheridan. This place, south of Waukegan, will require a water supply. The works have been designed by the U. S. Engineers, at Washington, D. C.——Morgan Park. The new works are completed. The water is taken from an artesian well 1,083 ft. deep, and pumped to a tank with a capacity of 100,000 galls., which gives a gravity fire pressure.——Centralia. A break occurred recently in the wall of the Illinois Central reservoir, and the city was without water for a few days, as it is supplied by the railway company.——Jerseyville. The City Council has plans for the erection of water-works, utilizing the new artesian well which was sunk 2,080 ft. in 1888. The plans will probably be adopted and the water-works completed by July.

Minnesota.—Winona. The Water-Works committee has recommended the laying of a considerable amount of 6 and 8 in. mains.

Texas.—Belton. The lease of the water-works has been purchased from MATTHEW DOW by D. A. CHAMBERLIN and NELSON SMITH.

Oregon.—Albina.—The Albina Water Co. has had plans prepared for a new reservoir, to replace the one that gave way some time ago.—— St. John's. A water supply has been struck at a depth of 140 ft. and a pumping engine has been purchased to pump the water to a reservoir.

Washington Territory.—Port Townsend. The Clear Creek Water Co. has been incorporated to build water-works. DAVID A. WALKER is interested.

Indian Territory.—Ketchum. A company has been organized to build water-works. Capital stock, $10,000.

Canada,—Goderich, Ont. Harding & Leathorne, the contractors, have completed their contract and the works have been tested. The supply is taken from 4 artesian wells 300 ft. deep, and two more are to be put down to ensure an ample supply in case of emergency.

Special Reports of Water-Works Construction.

Reynoldsville, Pa.—

The following is from THOS. H. SCOTT:—The Reynoldsville Water Co. began the construction of water-works in October 1888. They are now completed and in operation. Water is pumped to a reservoir, and there are two tanks, each having a capacity of 2,400 galls. The constructing engineer and contractor was R. B. THOMAS, Clarion, Pa. There are 1½ miles of 6-in. mains and a pressure of 75 to 100 lbs. The pipe and specials are from R. D. Wood & Co., Philadelphia, Pa., and the pumping machinery from John Jenks, Brookville, Pa. The company receives $1,500 per year for 18 fire hydrants. Capital stock, $12,000. Officers, F. K. ARNOLD, President; M. M. DAVIS, Secretary. Population of town, 4,000

Springfield, Kan.—

The following is from M. L. TURNER:—The Springfield Light, Heat & Water-Works Co. began the construction of water-works in May, 1888, under a 20 years, franchise. They will be completed in April, 1889. The designing engineer was J. S. HUMPHREY, Garden City, Kan. Constructing Engineer, E. A. WATSON. A 700,000-gall. Dean pump raises water from a well to a 12 by 80 ft. stand-pipe, furnished by E. E. Palmer & Son, Kansas City, Mo. There are 1¾ miles of 10 to 6-in. cast-iron pipe, from the South Pittsburg (Tenn.) Pipe Foundry, and 20 hydrants from the Chapman Valve Mfg. Co., who also furnish the valves. Services are lead and galvanized iron, and Crown meters are used. The company has a capital stock of $30,000, and $16,000 of 7 per cent. bonds. Estimated cost of works is $26,000. E. A. WATSON is Superintendent. Population 1,200.

North Yakima, Wash. Ter.

The following is from GEO. W. RODMAN, City Clerk:—The council has granted a 25 years' franchise to GEO. F. WOOLSTON of Helena, W. T., and is about to enter into contract with him, for a Holly system of water-works. Water from the Natchez river will be conveyed by gravity to a stand-pipe. Estimated cost is $75,000. Works will probably be completed Jan. 1, 1890. Population of town, 3,000.

Port Arthur, Ont.

The following is from ZEPH. MALHIOT, of Becancour, P. Q.: The Port Arthur Water-Works Co. will commence work at once upon a gravity system of water works. Supply will be taken from the river or McVicar's creek. Designing Engineer, ZEPH. MALHIOT. There will be 4 miles of mains. Estimated cost, $150,000. The officers are: M. DOWNIE, President; JAS. CONNER, Manager. Population of town, 5,000.